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A SWISS LAKE STEAMBOAT.

SUMMER travel has, for the last twelve years, been on a constant increase upon the principal lakes of Switzerland and Northern Italy—regions that are entered every year by hosts of tourists who are brought thither by pleasure trains.

To respond to the needs caused thereby, transportation companies have had to organize regular lines by means of perfectly equipped boats, which offer all the comfort desirable, and which make sailing upon the lakes of Switzerland and Italy one of the principal attractions of pleasure traveling.

It has appeared to us that it would prove of interest to our readers if we published in this place an illustrated description of one of the most remarkable types of these boats, and for this reason we have applied for material to Messrs. Escher, Wyss & Co., of Zurich, who have built more than three hundred and fifty of them for various parts of the world.

The type represented in the accompanying engraving is that of the Helvetia, which has been running on Lake Zurich since 1874, or of the Mont Blanc, which was launched at the same epoch on Lake Geneva. Each of these boats, all furnished and ready for running, costs the sum of 400,000 francs. They are heated throughout by steam derived from the boilers. They have a nominal power of 120 horses, and their speed is 26 kilometers per hour. Their length between the perpendiculars is 64 meters, their draught is 1·3 m., and the number of passengers that they carry is 1,500.

General Description of the Boat.—Fig. 1 gives an external view of the boat on a scale of 1 to 600; Fig. 2 represents a longitudinal section on a scale of 1 to 225; and Fig. 3 a plan on two different levels; Figs. 4 and 5 give transverse sections made respectively on the lines 5—6 and 7—8.

The hull of this vessel is entirely of iron. It is, as before stated, 64 meters in length between the perpendiculars, and its sides are 2·625 m. in height. The motor, *m*, which is located at the bottom of the hull, is a compound engine of a nominal 120 H. P., but capable of giving an indicated 600 H. P. It is supplied by two reversed flame boilers, *c*, each having three fireplaces. These boilers are registered at seven absolute atmospheres. On the extremity of the motive shafts are mounted the paddlewheels, *m'*, 4·1 m. in diameter and 2·6 m. in width.

On a trial trip the speed obtained was 26 kilometers per hour, with a consumption of 650 kilogrammes of coal.

The front part of the hold contains a chamber, A, in which are stored ropes, etc., and which is reached by means of a stairway, *a*. Back of this room there is a kitchen, B, in which is prepared the food required by second-class passengers, and which is served in the dining saloon, D. This latter is about 11·5 m. in length, and is reached from the lower deck, *p*, by means of a stairway, *d*. All around it there are arranged wooden benches, tables, and stools.

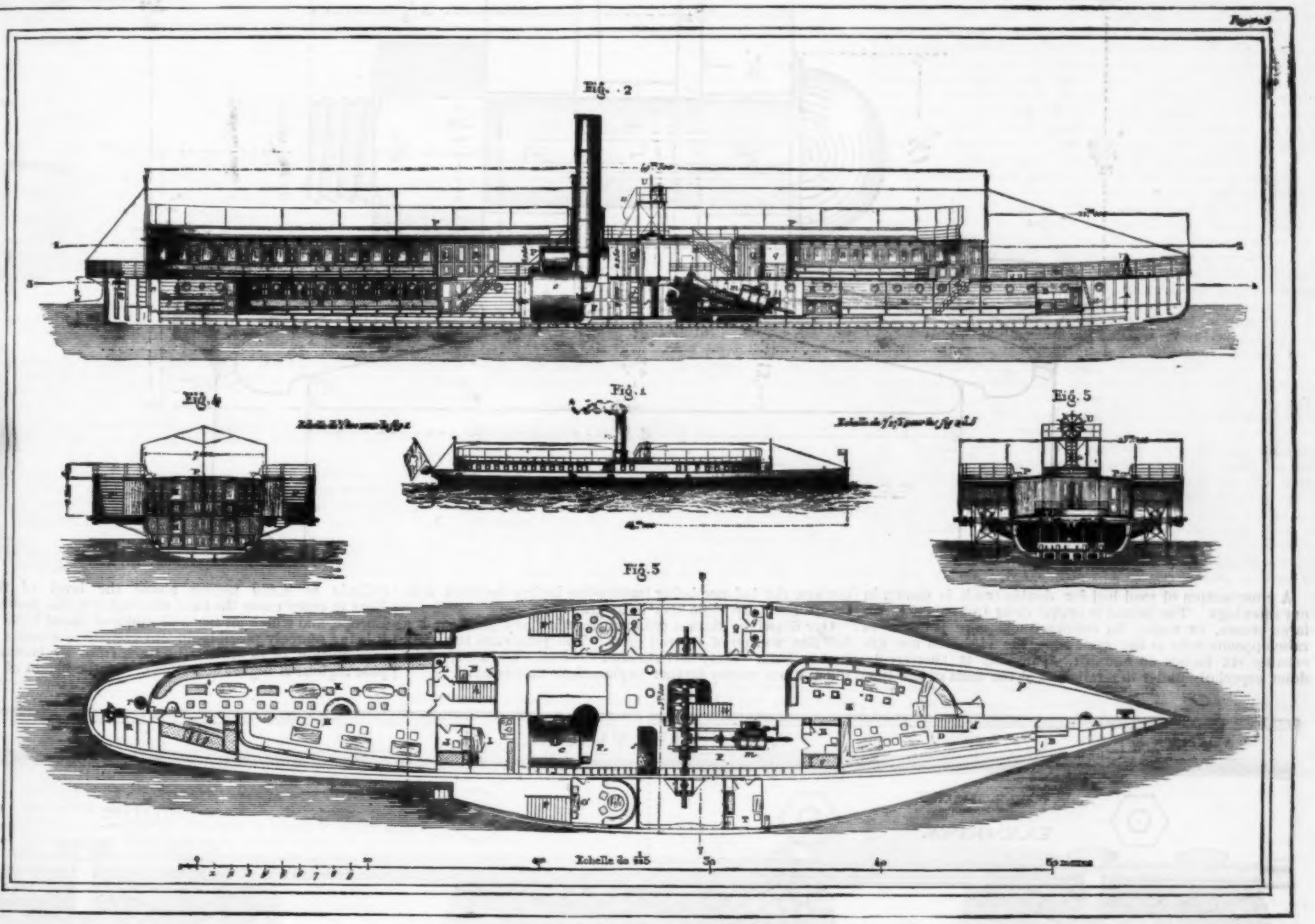
This saloon is separated from the engine room by a series of three cabins, E, furnished with lounges, tables, and chairs, and designed for the use of the crew, enginemen, and stokers, who have direct access from the room, F. This latter is 12 meters in length and contains the engines, *m*, the boilers, *c*, and the coal-bin, *s*. It is reached by means of an iron ladder, *f*. Behind, we remark, in the first place, near the rudder, a small room, R, which is reached by an iron ladder, *r*, and through a door in which access is had to the sleeping apartment, G. In front of the latter there is a saloon, H, to which first class passengers descend through the stairway, *h*, when the weather will not permit them to remain on the upper deck. The saloon, H, like all the other rooms on the same level, is lighted by scuttles. Leather-covered benches are arranged all around, and tables are set in the free space for persons who desire to dine. It was to satisfy this need that the room, I, was reserved for a kitchen. Alongside of this latter we remark the captain's quarters, J. On the first deck we find the grand saloon, K, 12 meters in length, which is reserved for first class passengers. This saloon is brightly lighted by numerous large windows, which permit of a view of the scenery being had. It is elegantly furnished, and the seats are covered with red velvet. Externally there is a narrow passageway all around the saloon.

On coming out of saloon, K, we see to the left the entrance to a water-closet, L, alongside of a small office, N, for the officers. Alongside of this latter is a stairway, *h*, which leads to the saloon, H.

Toward the center of the boat, on each side of the wheels, we remark (1) two small smoking rooms; (2) the office, T, of the ticket agent; (3) a urinal, Q, and water-closets, *q*, for gentlemen; and (4) a water-closet, Q', for ladies.

In front there is a saloon, S, which is designed for second class passengers, as is also the free space on the deck all around it. All this first deck is covered by the upper deck, P, which is reserved exclusively for first class passengers, and which is the most favorable place for enjoying a view. In summer, to shelter the passengers from the rays of the sun, which are often very intense in Switzerland and Italy, an awning is stretched over this entire deck.

In the center of this deck is seen the captain's bridge, U, which is reached by means of the stairway, *u*, *u'*.—*Publication Industrielle.*



A SWISS LAKE STEAMBOAT.

OLD AND NEW ATLANTIC STEAMERS.

The wonderful performances of Atlantic steamers, comparatively new, have been so prominently kept before the public that there is some danger, says the *Engineer*, that the efficiency of Atlantic steamers not quite so new will be overlooked. There are not wanting certain heretical individuals who maintain that the Alaska and other vessels of her type owe their speed to the enormous power developed by their engines, and not to the inherent virtues of their model. The opinion is strengthened by some recent Atlantic performances. The Alaska and Britannic left Liverpool at 5 and 6 P.M. respectively, on Saturday, June 2, and both left Queenstown at 9:30 on the Sunday morning.

The Alaska arrived at New York at 10 A.M., and the Britannic at 8 P.M. on the following Sunday, the mean time being about—Alaska, 7 days 5 hours, and the Britannic 7 days and 15 hours. Considering that the Alaska is a two year old ship of 6,950 tons, indicating 10,500 H.P., and that the Britannic is nine years old, 5,004 tons, and about 4,500 H.P. only, this trial of speed is more creditable to the Britannic than to the Alaska. If the Britannic had the same horse power in proportion to power as the Alaska, she would have 7,500 or 3,000 more than she has. These passages give for the Alaska a speed of 16·1 knots, and for the Britannic 15·2 knots. According to Mr. Froude, increasing the Britannic's power by two-thirds would increase her speed by 3·4 knots, raising it to 18·6 knots, equal to a passage of 6 days 5 hours, or 1 day shorter than the Alaska.

As a matter of fact, there is very small doubt that she would be little short of that speed. By increasing her power one-third, or to 6,000 horses—the same as the Arizona—her probable speed would be 17 knots=6 days 20 hours. In fact, when the boilers of the Britannic and Germanic require renewing two or three years hence, they could be made more than a match in speed for any steamers now running, by giving them the moderate power of 6,000 horses, which their strength of construction would certainly well stand, as in the matter of model these vessels are apparently unequaled by those of any other line. Again, the Servia left New York at 1 P.M. on June 13, and the Britannic left

New York at 2 P.M. on June 14. The Servia arrived at Queenstown at 9:40 A.M. on June 21, and the Britannic arrived at Queenstown 11:30 A.M. on June 22. The Servia's mean time was 7 days 16 hours 15 minutes; the Britannic's mean time was 7 days 17 hours. In other words, a ship of 7,390 tons and 10,000 H.P. only gained 45 minutes on the run from New York on a vessel of 5,004 tons and 4,500 H.P. The Britannic was built by Messrs. Harland & Woolf, and engined by Messrs. Maudslay, Sons & Field.

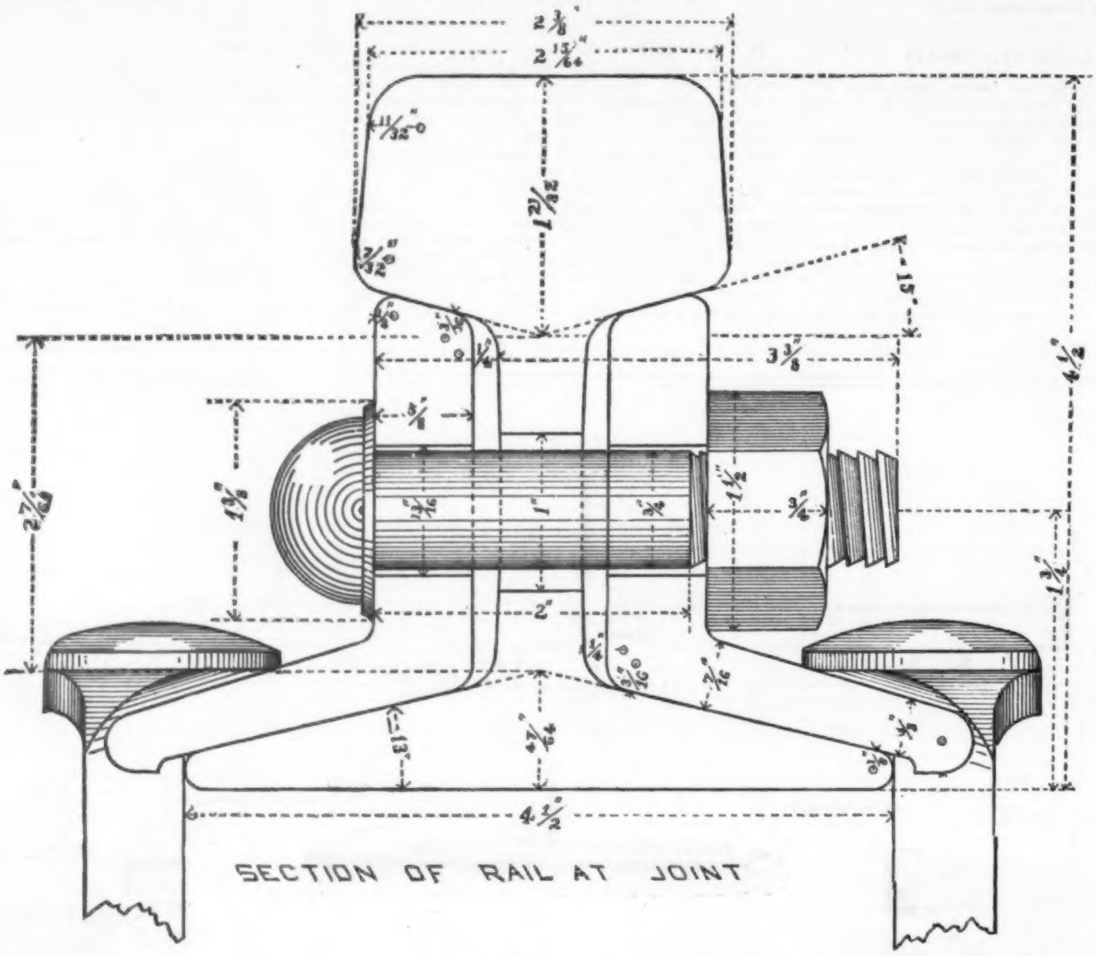
A STANDARD TRACK AND RAIL JOINT.

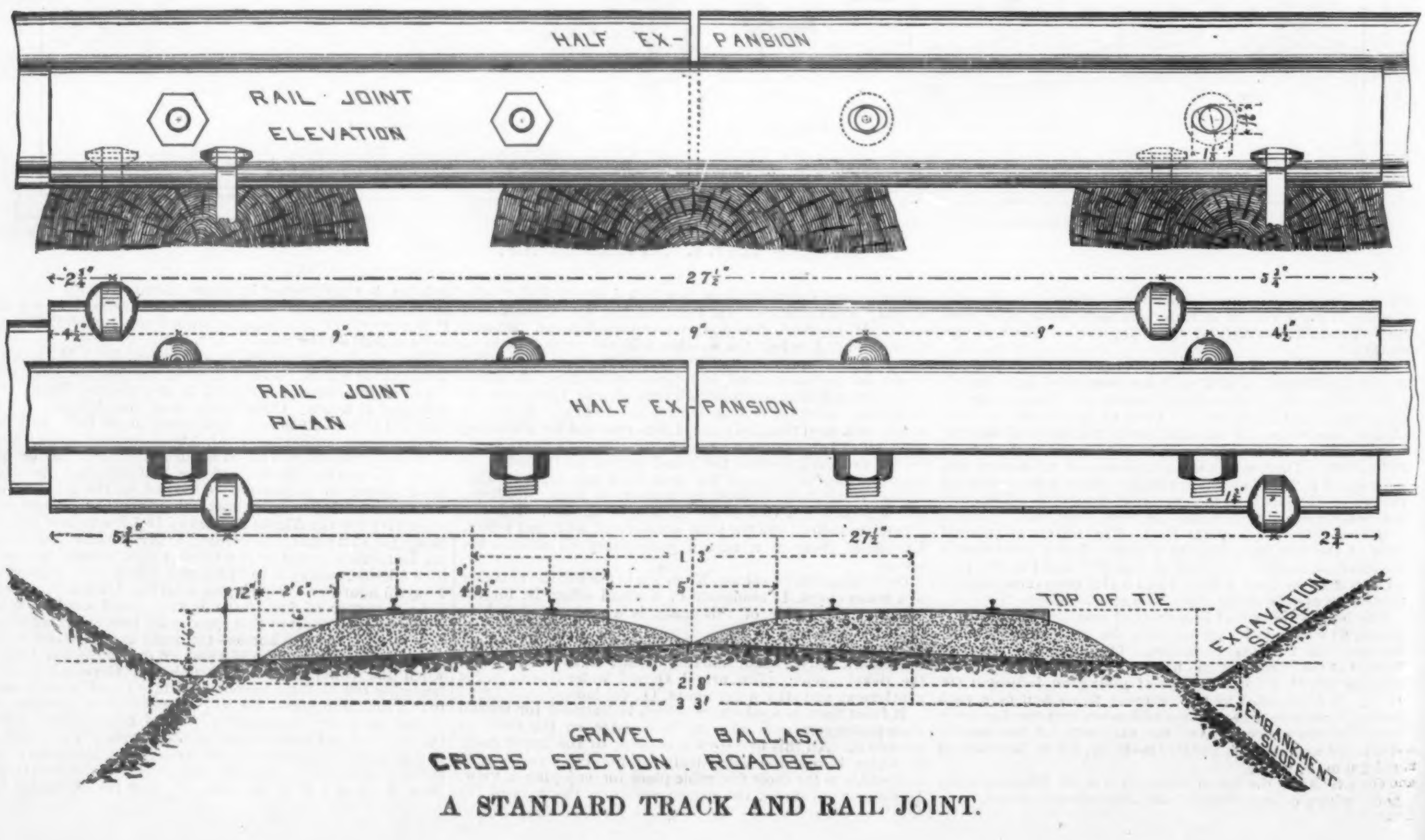
We present this week the main features of the standard track and joint now used by the New York, West Shore & Buffalo Railway.

A cross section of road bed for double track is shown in our drawings. The ballast is gravel clear from clay, earth, large stones, or roots. In raising tracks care is taken to raise opposite rails at the same time, the elevation not exceeding six inches at one lift. Tamping is thoroughly done, especially under the rails and at the ends of the ties, which are carefully brought at right angles to the track. After the track has been brought to the line indicated by the center and grade stakes, the ballast in the center of the bed is thrown in to the surface of the ties and sloped outward from the center of each track, clearing the base of the rail by one and one-half inch and leaving the ends of the ties exposed from three inches from the bottom. The ditches between the tracks and at the sides of the cuts are then cleaned out as indicated in the drawing. Surface drains to convey the water across the track are placed where needed, and are ten feet long, eight inches square inside, and made of two-inch hemlock plank.

The ties directly under the joints of the rails are ten inches wide, all the rest being eight inches. The three ties upon which the fish-plates rest are set fifteen inches between centers, the balance being twenty-five inches between centers. They are eight feet in length.

Our drawings show a reduced elevation and plan, and a full size section of the rail joint. The plates are thirty-six inches long. Sixty-seven-pound steel rails are used. The illustrations render further explanations unnecessary.





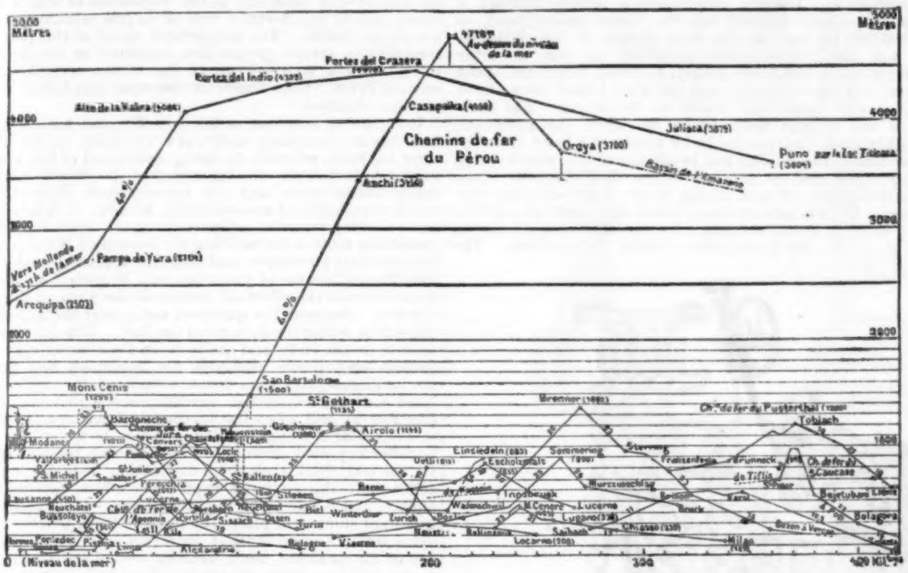
A STANDARD TRACK AND RAIL JOINT.

COMPARATIVE ALTITUDES OF MOUNTAIN RAILROADS.

We reproduce herewith from the *Revue Générale des Chemins de Fer*, an interesting diagram giving the comparative heights of the principal mountain railroads of the world.

As may be seen from a simple inspection of the cut, the railroad from Callao to Oroya, in Peru, reaches the highest altitude, for, in crossing the Cordilleras of the Andes, with a grade of 40 millimeters per meter, it reaches an elevation of 4,778 meters above the level of the sea, a height within 50 meters of that of Mont Blanc. Along with this road must be cited another Peruvian line—that which starts from Mollendo, on the Pacific Ocean, passes through Arequipa, and runs to Lake Titicaca, reaching at Portez del Crezera the altitude of 4,470 meters above the level of the sea. Next in order come the lines that traverse the mountains of Europe, and which all reach altitudes of about 1,200 meters, it being scarcely possible in our climate to secure a regular exploitation, or to protect the track from avalanches in Alpine regions at higher elevations. As the height of the de-

files of the Alps is generally about 2,000 meters, the crossing is effected by a subterranean passage 800 meters below. We may cite, for example, the crossing of these mountains by means of the Mont Cenis Tunnel, which is excavated at a height of 1,300 meters, and is reached by gradients of only 30 millimeters toward Modane and St. Michel on the French side, and toward Suze on the Italian side; and the crossing of the Saint Gothard by the tunnel recently constructed at an elevation of 1,150 meters One will likewise remark the line that traverses the Brenner in running from Innsbruck to Botzen, and which reaches the altitude of 1,350 meters; the celebrated Semmering line, which runs from Vienna to Bruck through Gloggnitz and Murzzuagschl and traverses the mountain through a tunnel at an altitude of 900 meters; and the line from Franzenfeste to Lienz, which reaches a height of 1,200 meters. The line from Poti to Tiflis in the Caucasus is especially remarkable for its enormous gradients of 45 millimeters, which thus exceed those on the line from Callao to Oroya.



COMPARATIVE ALTITUDES OF MOUNTAIN RAILWAYS.

It is especially in Switzerland that we meet with the most curious lines, both as regards the altitude that they attain, and the country that they traverse. We may cite the lines of the Jura, from Neufchatel to La Chaux de Fonds, and that from Pontarlier to Lausanne, both of which exceed the altitude of 1,000 meters; the line from Berne to Lucerne through Escholtzmalt, which rises to 855 meters; the line from Rorschach to Saint Gallen, which runs up to 675 meters; that of Utliberg, which starts from Zurich with a grade sometimes reaching 70 millimeters, the strongest that has ever been given a simple adhesion line in Europe, and rises to 815 meters; and that which starts from Wadenswyl and rises with a gradient of 50 millimeters to the formerly celebrated Notre-Dame des-Ermites at Einsiedeln, at 883 meters altitude.

Among the Italian lines we may cite the one from Genoa to Alexandria, which crosses the Apennines at an altitude of 400 meters with gradients of 35 millimeters; and the one from Florence to Bologna, which crosses the mountains at an elevation of 607 meters with gradients of 25 millimeters.—*La Nature.*

MERSEY SALT AND BRINE COMPANY.

THE new works at Marbury, belonging to the Mersey Salt and Brine Company, are rapidly approaching completion. The object of the company is to pump brine at Marbury convey it through pipes to Runcorn (a distance of 12 miles), and there manufacture white salt.

The Marbury portion of the company's plant is divided into two almost square sections, each being bounded by a substantially built brick wall, about 6 feet in height, and both being connected by a cinder road, fenced in, about 300 yards long. The upper section is contiguous to the canal bridge in Marbury Park, the lower section being in the direction of Northwich.

The boundary wall of the lower section incloses the shaft, an engine and boiler house, and two reservoirs. The shaft is at present 164 feet deep; but it has yet to be deepened another 30 feet by Mr. E. Timmins, mechanical engineer, of Runcorn, who is a sub-contractor, and thus the shaft, when completed, will be nearly 200 feet in depth. The engine power has been supplied by Messrs. James Watt & Co., of London, and Soho, Birmingham. Outside the engine house are three reservoirs, which are used for condensing purposes.

The upper section of the Marbury portion of the undertaking is termed the "forcing station," and inclosed within its boundary wall is an engine and boiler house, which also has a mechanic's shop attached. Just outside the engine house at the forcing station is a tank 50 feet in diameter by 11 feet deep. The tank is bricked, and fenced in with iron rails. Into this tank the brine is forced from the shaft, the level being about 8 feet higher. From the forcing station to the reservoir at Runcorn, the brine is conveyed through iron pipes a distance of about 11 miles. The reservoir is about 140 feet higher than the tank at Marbury, and large air chambers are made use of at the forcing station as helpers in the forcing process. The bore of the mains is 15 inches, and the thickness ⅝ inch.

From the forcing station they pass over the canal bridge, where they are incased in wood and elevated a few inches above the parapet, thence through Cogshall Park and Merryfall Wood. After crossing the Warrington Road, close to Whitley Brook, the pipes run on to Sevenacre Wood, thence, passing Dutton, they continue along the side of the London and Northwestern Railway toward Liverpool, passing Sutton Weaver, the Flood Brooks, and Rock Savage, and then on to the reservoir, which is situate on Runcorn Heath. At Flood Brooks, about two miles from Runcorn, the pipes pass through a ravine a little distance above the ground. The reservoir, which occupies about an acre and a half of land, is near Pewithall, about half a mile from the Runcorn Waterworks pumping station, the level of it being not much below that of the Runcorn Waterworks reservoirs. The depth of the company's brine reservoir is 14 feet 9 inches from the top of the embankment. The reservoir is capable of holding about two and a half million gallons of brine. Under Runcorn Hill a tunnel has been cut for the better conveyance of the pipes and possible future contingencies, the length of it being 1,960 feet. The tunnel, which is bricked where the rock is soft, has a space of 6 feet by 4 feet. There are two entrance shafts to the tunnel's mouths, the first being opposite the Runcorn Waterworks pumping station, and the second at the foot of the quarry hills facing the Mersey; each is square, well built with stone and brick, and covered with a large flag.

The engineer to the company is Mr. J. F. Bateman, Past Pres.Inst.C.E., F.R.S., he being assisted by Mr. W. Fox, M.I.C.E.; Mr. R. A. Sumner is the resident engineer at Runcorn, and Mr. G. C. Denison at Northwich. The contractors for the works are Messrs. Smith, Finlayson & Lucas, Westminster, whose manager in Cheshire is Mr. Bowles.—*Building News.*

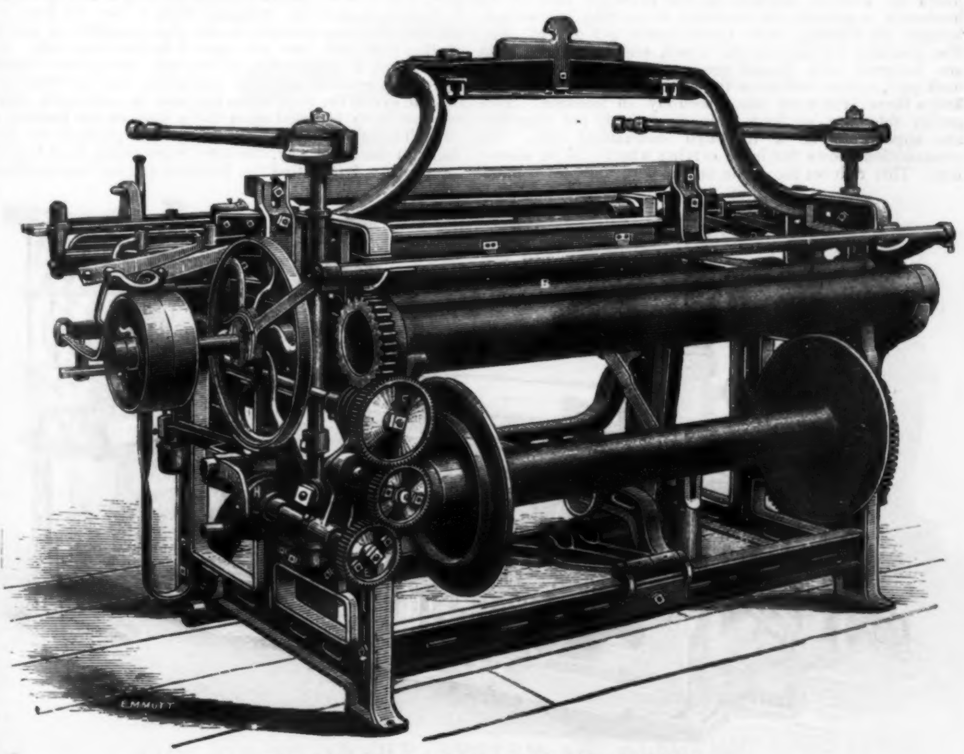
KEIGHLEY'S IMPROVED LOOM.

WITH the object of increasing the speed of weaving, bettering the cloth, and simplifying the work of the operative, Mr. George Keighley, machinist, of Burnley, has given a good deal of attention to the improvement of the light-running, high-speed looms for cotton or Bradford cloths.

In this example three points have been kept in view by the inventor: (1) To keep the warp under positive control, and exactly measure its delivery for every pick. (2) To weave with a constant tension on the warp threads (shed open or shed closed), and from beginning to end of warp. (3) To work the take-up by a positive connection with the let-off motion, and at the same time to make by this means a determinate and easily regulated allowance for the shortening of the warp in weaving.

With regard to the first point: in the engraving, which represents the back of the loom, the usual fixed back beam or sometimes vibrating beam is replaced by the measuring roller, A. Behind this is a presser roller, B, which is covered with a tight layer of cotton cloth, over which the yarn from the warp beam is first conveyed; the yarn next passes between the two rollers, and then, after nearly covering the whole circumference of the measuring roller, it passes over the oscillating beam, C, and thence through the healds and reed in the usual way. The weights and ropes on warp beam are dispensed with. The measuring roller is worked from the tappet or low shaft through a clutch, H, and the wheels, E to F, of which F is a change wheel. This latter actuates the measuring roller through a worm and wheel, which are clearly seen. The shaft of wheel, F, is carried through to the front of the loom, and by a set of wheels, one of which, on the end of shaft of F, is a change wheel, and a worm, it actuates the taking-up roller, which is made of exactly the same size as the measuring roller. We will explain this part before we proceed further, bearing in mind that the primary movement is the let-off. The teeth of the wheels at back are so numbered and the action timed that the number of teeth in wheel, F, is the same as the number of picks per inch of warp. If wheel, F, has 100 teeth, there will be 100 picks to the inch of warp. The large surface of measuring roller enveloped by the warp insures certainty of delivery, uniformly and without slipping. The next point is with the taking-up roller. This, as we have said, is of the same diameter as the measuring roller, and therefore, if worked at equal speed, would take up cloth as fast as warp was delivered. But this would not be possible, for an allowance of so much per cent. must be for the length the warp loses in weaving. The amount of this depends upon three factors—the thickness of weft, the number of picks, and in a slight degree upon the thickness of warp ends. Given these three items—of course they are always known—and from experience the manufacturer knows for a particular cloth the percentage of loss of length of warp in weaving. Say, for illustration, it is 10 per cent. This means that the taking-up roller, being of the same size, must run 10 per cent. slower than the measuring roller that is letting off. Now the wheel working the taking-up roller has always 100 teeth, and as there is a shortening of 10 per cent., then change wheel at front and on shaft of F will require 90 teeth; and, always, the change wheel in front will have the same percentage less teeth than wheel on taking-up roller that the length loses in weaving. Bearing in mind that this wheel has always 100 teeth, it is only necessary to remember that the change wheel gearing into it should have one tooth less for every per cent. lost in length. If the loss is 20 per cent., the change wheel will have 80 teeth and so on.

The next point is keeping up the constancy of tension on the warp between pick and pick, which is obtained by the vibrating back beam, C. The cams that work this beam are exactly similar in outline to the treading tappets, but of shorter throw, because, acting in the close angle where the warp passes over back beams, their effect is greater. The result is that as the shed opens the vibrating beam falls back and allows at every point of the opening the exact amount of yarn to give that opening without extra stretching or slackness. A little reflection will show that this must be the mechanical effect of the similarity of contour of the treading tappets and the vibrating beam cams. It has been tested by observing that a silk thread tied to the front of loom and passed through the healds and over the back beam remained stationary at the free end at back when the loom was run round. The next essential point is to meet the state of affairs that occurs when the loom is pulled up from the shuttle running empty or weft braking. In ordinary weaving from 2½ to 3½ picks may be made before the brake can stop the loom—that is to say, the warp is let off for this number of picks and no weft is put in. When starting again it is therefore necessary to make say three picks before the take-up is allowed to act in order to keep the cloth level at this point. With the usual taking-up motion this is done by the weaver keeping the catch out of the ratchet wheel by the trigger for the first few picks, as near as can be guessed. In Keighley's the same result is obtained, with this difference, that an exact allowance may be made for any number of lost picks. At the moment the weft fork acts, and the brake is put on, the clutch, H, is put out of gear. When the loom is started the handle puts the clutch into gear, but it does not actuate the letting off and taking up until a few picks have been made, because its teeth are a certain distance apart. The nearer they are the more quickly it operates. By this arrangement Mr. Keighley claims that cracks in cloth, about which so much has lately been said in our columns, may be entirely prevented, and for the whole it is claimed that together with a higher speed—about 260 picks



KEIGHLEY'S IMPROVED LOOM.

per minute in a loom 40 in. wide—a better and more level cloth is produced, with less attention on the part of the weaver or tackler. As regards the former, the work reduces itself to shuttling and piecing up the broken warp ends, an important advantage where skilled labor is scarce.

As may be seen, the loom illustrated has one warp beam only, but from our description it will be obvious that any number of warps, wide or narrow, of various colors or material, can be woven at the same time—in fact, we understand that in the earlier experiments with this loom the yarn was taken off from a creel.

A few other features may be alluded to. If necessary, as after removing a float, the whole warp can be turned back at the same tension till the cloth is again against the reed; or supposing from some cause the warp loses its tension, it can at once be corrected. If thicker weft is used by mistake, it soon indicates itself, as the weaving cannot be proceeded with. The space afforded in front of the loom by the height of the taking-up roller allows (as we are informed) the cloth (printers) to be wound on the cloth beam 360 yards, and this more accurate as to length than the usual 120 yard pieces. It thus becomes only necessary to take off once a week as against five times a fortnight as customary, saving five to six yards per loom per week in over lengths, the practice being to weave rather long to be on the safe side. It is expected that the accurate and measurable nature of the motions we have described will render this unnecessary, as the manufacturer can calculate exactly what he is doing, and can then be certain that he is doing it.—*Textile Manufacturer.*

IMPROVED SELF-ACTING MULE FOR COTTON SPINNING.

THE mule headstock we now illustrate is constructed by Messrs. Asa Lees & Co., Limited, of Oldham, and contains a number of improvements that they have introduced from time to time during the past few years.

The mule is described as the low headstock, which has the advantage of allowing a longer driving belt. It is now the practice of good makers to cast the back part of the head in one piece, and to let the main slips rest upon planed faces, on the feet of the back part. This construction is adopted and partly extended, inasmuch as the bonnet for carrying the outer bearing of the rim shaft is also cast in one with the back. The merit of this is that joints are avoided, rigidity in the principal part of the headstock is gained, and accuracy in erecting is obtained, because the bearings once bored cannot get out of line. The brackets for carrying the levers, etc., are faced, and are tongued with planed grooves in the faces on the back part, which facilitates the setting of the brackets, and keeps them afterward more securely in position. Altogether, this part of the machine is strongly put together, and appears to be a thorough mechanical job. The construction allows for large driving wheels (16 in. diameter). This reduces the strain on the belt, and correspondingly larger backing-off cone, which is made 18 in. diameter, and is therefore better up to its work.

We will now consider the improved motions, which, it is needless to say, were patented as they were perfected. We will tabulate them:

1. Independent driving of cam-shaft, backing-off, and taking-in, by a band, with tightening apparatus.
2. Strap-relieving motion.
3. Self-acting, anti-snarling motion.
4. Governing motion for cop bottom.
5. Patent backing-off cam.
6. Locking motion for cam-shaft lever.
7. Instantaneous winding click.
8. Full cop-stopping motion.
9. Improved cam-shaft.
10. Safety arrangement for drawing-out, backing-off, and raking-in levers.

(1) The horizontal taking-in shaft, which works parallel to the rim shaft, has three duties to perform, viz., to drive the cam shaft continuously, to back off, and to take the carriage in. Usually, this shaft is driven through a range of toothed wheels, off the loose pulley, and on account of the tendency to high speeds at which mules are now run, it becomes necessary to use a rather small pinion on the loose pulley, to bring down the speed of the taking-in shaft, and it was found that these wheels were much too liable to breakages. The makers of the present mule prefer to drive the horizontal taking-in shaft independently by means of a band from the countershaft, the rattling and breakages of the wheels being thus avoided, and on account of the slight elasticity of the rope the backing off and taking in are more smoothly performed. By this arrangement, which has been adopted for some time, it is not necessary for the belt to work for an inch or so on the loose pulley during the spinning. The slotted bracket, A, and the adjustable carrier wheel are for the purpose of tightening this band, the pulley on the cross-shaft being treble-grooved for the band to obtain a good purchase on the rim. (2) The strap-relieving motion is an ingenious arrangement for gradually moving the strap off the fast pulley as the outward run is being nearly completed, and therefore before the long lever is acted upon and the cam changes. Usually, the strap fork is actuated by the cam shaft very suddenly at the end of the draw. The backing-off cone, therefore, which goes into gear nearly at the same time, does so when the spindles are running at full speed, and is heavily worked in stopping them before backing off. Shifting the strap abruptly is also objectionable, on account of the wear and tear put upon it by the strap fork. The new motion is designed to obviate this, and acts as follows: The strap lever is made in two parts, one of which carries the eye of the fork at the top, and is prolonged downward so as to be acted upon by a stop on the backing-off rod. The other part of the strap lever passes to the cam-shaft in the usual way, the two parts being kept together by a spring, but so that the first part can act independently of the second part. As the carriage is reaching the end of its outward run, and before it gets on the catch, the fish-jaw on the carriage-square acts upon the backing-off rod, and this in its turn upon the strap lever. The strap is thus gradually slipped almost entirely from the fast to the loose pulley before the cam changes. The momentum of the carriage brings it to the holding-out catch, at which time the revolution of the spindles is almost stopped, so that the backing-off is easily and quietly performed. (3) In part connection with this latter mechanism is an anti-snarling and hastening motion, which is completely automatic. It consists of a lever, mounted on the side of the square, the free end of which is connected to the copping motion by the trial lever. The former lever has an incline, which at every inward draw comes in contact with a bowl on the strap lever, and pushes the strap on to the fast pulley before the cam changes. The benefit of this is two-fold. At the finish of the inward run, the speed being increased greater than that due to winding alone—this before the cam shaft acts, and therefore before the rollers are moved—the tendency to the formation of snarls is reduced, and if they form, it will be on the spindle point and not on the blade. The accelerated speed at this part also conduces to greater production, inasmuch as the speed of the spindles is well got up at the commencement of the upward draw. Cops firmer at the nose and better wound are also obtained.

It should be said that as the cop fills, the hastening motion acts imperceptibly earlier at every draw, the incline and lever we have referred to being connected to the copping motion. It this way the taper part of the spindle is always firmly wound upon, and the improvement claimed is that this is accomplished automatically, without, as is usually the case, needing frequent adjustment by the spinner. (4) The governing motion for building the bottom of the cop is simple, perfectly automatic, and does not require adjustment for the different counts of yarn that may be spun. Its working depends upon the effect of tension in the yarn on the counterfaller. Suppose the quadrant nut is near the bottom, and the cop in filling tends to wind too fast. This increases the tension on the ends, and pulls down the counterfaller. An endless band passes alongside the headstock and through the carriage-square from front to back of the mule. This band is connected to the quadrant screw in a simple way (see Fig. 2), and when the winding is going on all right it is stationary and doing nothing. When, however, the counterfaller is pulled down, by the increasing tension, beyond its normal limit, then, by a connection with the counterfaller shaft, the governor band is in effect fastened to the square, and is moved by the inward run. It then turns the quadrant screw and places the nut in a fresh position. The same action occurs at short intervals until the nut is at the top of the quadrant, the governing motion easily responding to the different states of the winding, and thereby, as it is claimed, giving firmer cops and keeping the yarn free from snarls. (5) The backing-off motion in this mule was patented by the makers a few years ago. It consists of a cam or snail plate, round which the chain passes, and which is worked in connection with the usual backing-off pulley. The cam is shaped to imitate the coils of yarn on the spindle—that is, in backing off it brings the faller wire down at exactly the same rate as the coils are unwound off the spindle. It is claimed that as in this way no sudden blow is given to the yarn, breakages are fewer, and the backing off is performed with ease and more certainty. (6) The next improvement we have to notice is a locking motion for the long lever that works the changes on the cam shaft, which is also designed to obviate an undesirable contingency. This lever is operated by the faller and counterfaller shafts striking against inclines on it at the finish of the inward or outward run of the carriage. On account of the vibration there is a tendency for the lever to drop out of time and make a change at the wrong moment. Two or three expedients have been tried to prevent this, which is a difficult problem, for while the lever must be kept securely up or down it must still yield when acted upon by the faller shafts. One plan is to rely upon springing the lever by passing it over a knob in the center of its motion, which plan, we understand, has been found to be unsafe, besides requiring, in the first instance, a nice adjustment which, from the wear that occurs, is not lasting. The method adopted in the mule illustrated is perfectly positive and mechanical. The front end of the change lever abuts against a short link acted upon by a spring, and the two form a knuckle-joint, which securely keeps that end of the change lever either up or down, but at the same time allows the change from one point to the other to be easily made. (7) The instantaneous winding click is an important improvement. This click is put into gear when the carriage is out, and during the backing off, by the locking of the fallers, and consequently is ready to turn the drum and wind with the first inward movement of the carriage. With this arrangement the two clicks cannot be in gear at the same time. With the usual form of click the carriage must travel a little, and turn the winding chain-barrel before the click goes into gear. This causes the ends to sag, and the winding to commence somewhat later. (8) An arrangement of great utility has been applied in the shape of a stopping motion for full cops. The production of cops of uniform size is very desirable—the tendency is for the spinners to make them too large; and then with weft cops there is the risk that they will not go into the shuttle. For doubling purposes it is much more convenient to have uniform cops, for in the doubling they will then run out together. Cops of uniform size and of known number also, when weighed in skips, supply a convenient means of checking the counts. It having been settled how many draws are required for a full cop, this number is made, and the stopping motion, which works in connection with the front incline of the copping rail, is adjusted to lock the taking-in rod at this point. The next doffing may then be relied upon to be exactly the same as the first to within three or four draws, an error of scarcely any significance. (9) The makers also claim improvements in the cam shaft. The catch is substituted by a friction clutch, with the view of obtaining noiseless working. Certainty of action is also claimed, it being stated that it works as perfectly at one draw in two minutes as at the normal speed. (10) The last improvement we shall allude to has been adopted for some time: it consists of an ingenious interaction between the drawing-out, taking in, and backing off levers, designed to prevent the possibility of either two of these operations taking place simultaneously. Any of these levers being thrown into gear will first disengage the one then in gear, and thus avoid a frequent source of breakages that exists when these levers act in virtual independence of each other. Altogether, this mule headstock is an excellent example of this type of machine, and the result of the attention it is obvious its makers must have bestowed upon its details does, we think, reflect great credit upon them.—*Textile Manufacturer.*

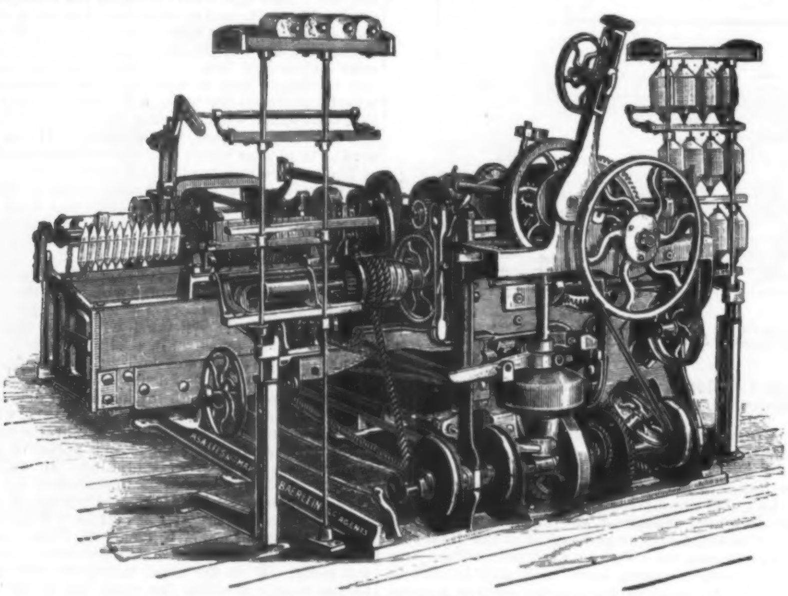


FIG. 1.—IMPROVED SELF-ACTING COTTON MULE.

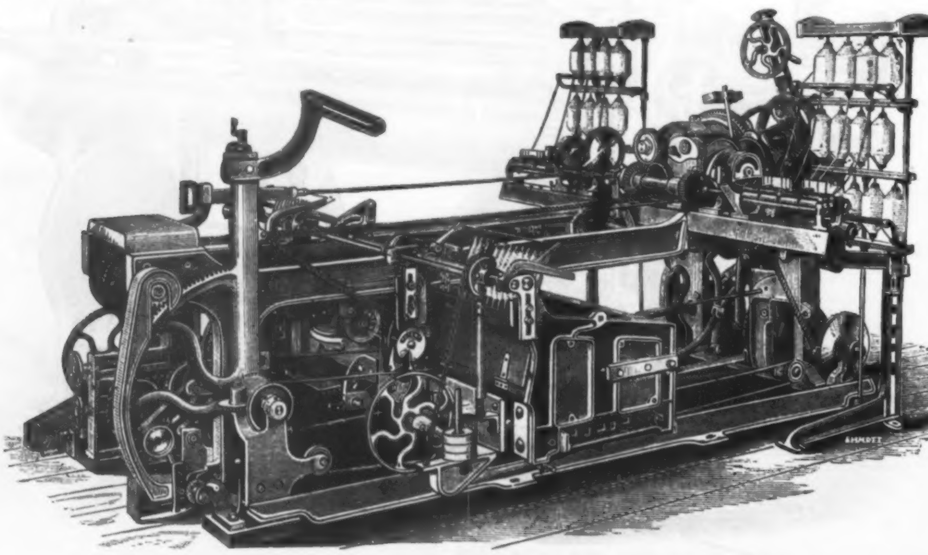
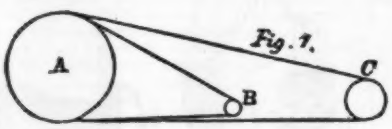


FIG. 2.—IMPROVED SELF-ACTING COTTON MULE.

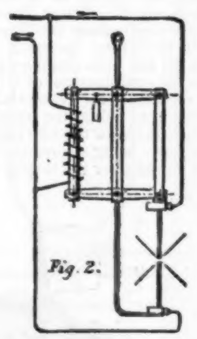
THE ZIPERNOWSKY SYSTEM OF ELECTRIC ILLUMINATION.

IN 1878, Messrs. Ganz and Co., of Budapesth, devoted a part of their extensive engineering works to the manufacture of electric light machinery, and adopted the system patented by Mr. Zipernowsky, to whom they also intrusted the management of this department. The Zipernowsky system embraces both arc and incandescence lamps and the dynamo machines necessary to produce the current for the lights, as well as all accessory appliances required for a complete installation. The first machine constructed on this system, in 1879, was designed specially with a view to feed several lamps, arranged either in parallel circuit or in series, and to admit of lights being worked at very great distances from the dynamo machines.

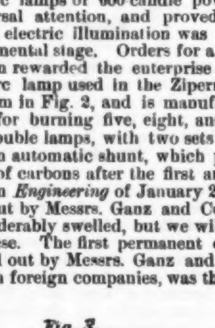
Considerable progress had already been made by Messrs. Ganz and Co. in 1880, especially in agricultural districts,



where electric light was used for various kinds of farming work during the night. The first experiments having been highly satisfactory, several installations were fitted up on the Government farm at Mezobegyes, and these have now been in regular use for three years and have met with general approval. The advantages of working thrashing machines at night, particularly during harvest time, are too well known to require special mention here; suffice it to say, that the director of this Government farm, Mr. Gluzek, found as the result of three years' experience that twelve thrashing plants fitted with electric light would produce more work than sixteen without it. The mode of driving the dynamos direct from the portable engine and without the use of an additional loose pulley is shown in Fig. 1, where the large circle, A, represents the driving pulley or flywheel of the portable, B that of the dynamo, and C on the right that of the thrashing machine. The two driving belts work one over the other on the engine flywheel, and the dynamo is fixed on a special frame at a convenient distance between the engine and the thrashing machine.

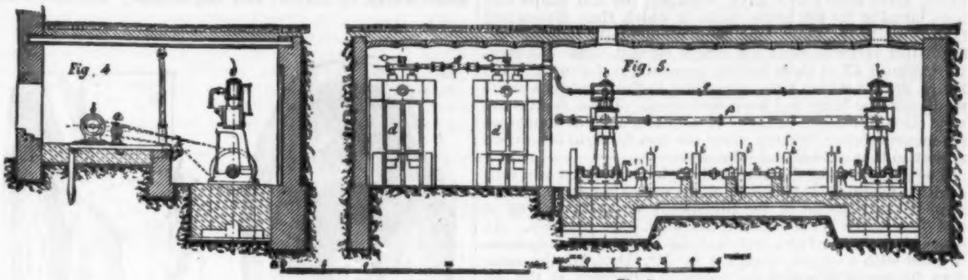


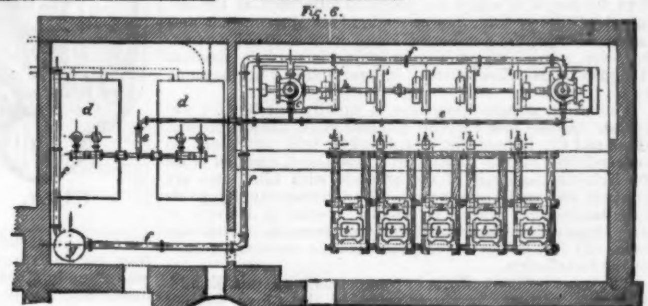
When, in May, 1881, the Crown Prince of Austria was received at Budapesth, Messrs. Ganz and Co. embraced the opportunity to make a grand show of electric lights, and erected thirty arc lamps of 600 candle power each, which attracted universal attention, and proved to the Austro-Hungarians that electric illumination was considerably beyond the experimental stage. Orders for a large number of installations soon rewarded the enterprise of Messrs. Ganz and Co. The arc lamp used in the Zipernowsky system is shown in diagram in Fig. 2, and is manufactured in three different sizes, for burning five, eight, and sixteen hours. The latter are double lamps, with two sets of carbons, and are fitted with an automatic shunt, which puts into circuit the second pair of carbons after the first are burned down. We published in *Engineering* of January 26 a list of installations carried out by Messrs. Ganz and Co. This list has since been considerably swelled, but we will here only mention a few of these. The first permanent electric light installation carried out by Messrs. Ganz and Co., after keen competition with foreign companies, was that at the skating

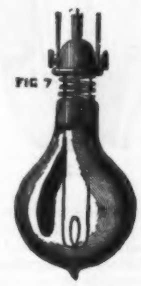


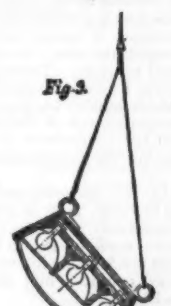
rink in Budapesth with ten arc lamps. This was followed by the harbor of Fiume with eight, the shops of the K. Hungarian State Railway with fourteen lamps, and the Szlatina mines with twenty arc lamps. All these installations, although the first in execution, are still in constant use, and give thorough satisfaction, while the lighting of Fiume Harbor may be quoted as an example of rapid work, the lamps being in working condition within one week of the order being received at the works.

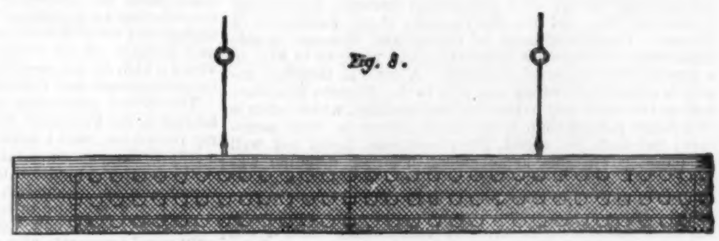
Since 1882 the firm have successfully carried out a number of installations with incandescence lamps, one of the largest being that of the National Theater in Budapesth, with 1,000 lamps of 20-candle power each. Fig. 3 represents a small block plan of this theater, where A is the stage, B the auditorium, C the engine and machine house, and D the chimney. The engine house is in a building adjoining the theater, where a spacious basement was available; this basement (see Figs. 4, 5, and 6) is divided by a wall into two parts, the smaller of which contains two water tube boilers, *d d*, of Buttner's type, one only being required for regular work, the second forming a stand-by. The steam supplies two vertical compound engines by Messrs. J. and H. Gwynne, which are placed one at each end of the engine room, the main shafting being arranged between them, with a friction coupling at each extremity, by means of which either one or the other, or both engines, may be used to drive the shafting. To the latter are keyed five carefully balanced driving pulleys, *i i*, running at 180 revolutions per minute, and these carry the belts for five alternating current machines, specially designed for lighting theaters with incandescence lamps. Each machine is capable of supplying









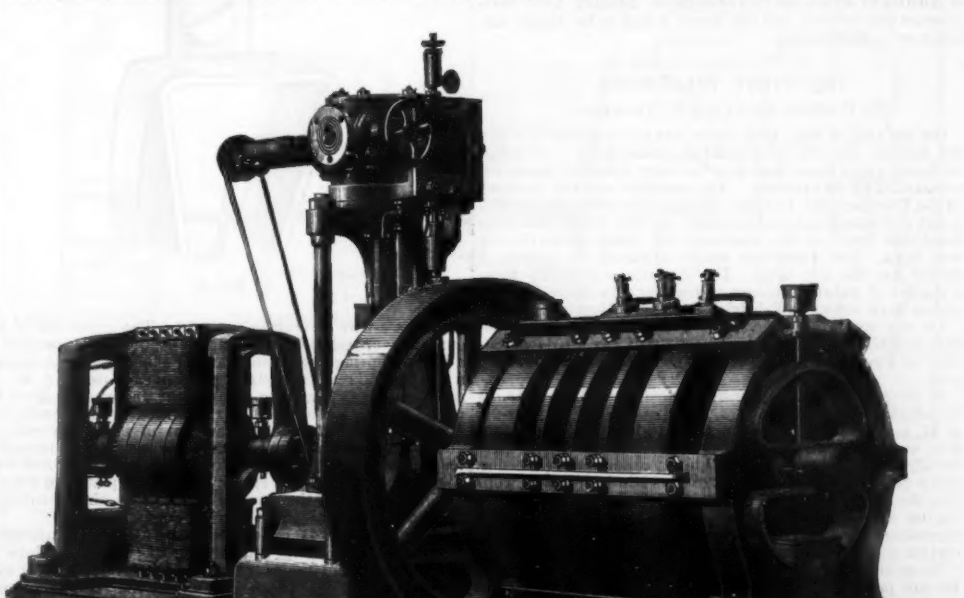


THE ZIPERNOWSKY SYSTEM OF ELECTRIC LIGHTING.

current for 250 twenty-candle power incandescence lamps requiring a difference of potential of 56 volts, and a current of 1·4 amperes each. Four machines are kept at work, the fifth serving as a reserve, and being for this reason electrically connected in such a manner that it can replace any one of the others. Each dynamo machine, *b*, is fixed with its exciting machine, *a*, on a framework, by means of which the continuous driving belts can be stretched while at work, an arrangement which was considered expedient for the safety of the installation.

The dynamo machines have each twelve induction coils; twelve circuits are taken off these, and are arranged parallel to supply the different lamps. The wires are led to a switch board fixed on the stage, from whence a larger or smaller number of coils can be thrown into circuit, and the intensity of the lamps thereby varied. The arrangement in the auditorium, where 128 lamps are fixed, admits of nine different grades of light, while for the stage, where the lights are divided, are seven flies with sixty lamps each (see Figs. 8 and 9), the intensity of which can be varied in twenty-one different grades. In addition, each fly, as a whole, can be varied in three degrees of light intensity, and each one of the flies is fitted, as shown in Figs. 8 and 9, with three rows of colored lamps, sixty in each row so as to enable the effects of morning or evening, or bright daylight to be produced easily

The dynamos used in this installation are alternate current machines of Mr. Zipernowsky's design; these have now been universally adopted by Messrs. Ganz and Co. for incandescence lighting, since an extended experience has proved that the lamps last much longer if supplied by alternate current machines than if supplied by continuous current machines. Experiments showed that with a continuous current, the carbon filaments of incandescence lamps showed



THE ZIPERNOWSKY SYSTEM OF ELECTRIC LIGHTING.

signs of wear at the point where the positive current enters after about 500 to 600 hours, producing a black spot on the globe (see Fig. 7). On the other hand, when working with alternate current machines, the lamps burn without deterioration for 1,200 hours and upward, after which time they begin to show signs of wear throughout the carbon, a slight deposit is formed on the globes, the carbon becomes thinner, the resistance greater, and the light less intense.

These experiences have been partly gained at the works, partly at an installation consisting of 220 incandescence lamps at the "Gisella" steam mills at Budapesth, and also at another smaller installation of sixty-four lamps at the flour mills of Mr. Stefan Schwarz, in Erlau. At the first named place, after ninety-five days' working, the 220 lamps had been burning for 980 hours each, in which time fifteen had failed, while six more had been accidentally broken. At the latter establishment the lamps burned since January, 1883, almost all of them having been alight for over 1,400 hours, during which time, according to the manager's statement, not one lamp had been destroyed. These results are very strong evidence in favor of alternate current machines for incandescence lighting, since the cost for light is reduced almost to that of coal and lubricants.

The Zipernowsky dynamo, although constructed as a self-exciting machine, is generally fitted with a separate exciter as in the installation of the Budapesth Theater (see Figs. 4 and 6), where *a* is the exciting machine, *b* the dynamo. In case it is to be used as a self-exciting machine, the dynamo is fitted with a switch, designed by Mr. Deri, of the same firm, by means of which the potential difference at the terminals of this machine can be made to remain constant and independent of the number of lamps in the circuit; when, however, a separate exciting machine is used, a rheostat designed by Mr. Zipernowsky is employed to gain the same end.

The same dynamo machine is equally suitable for arc lamps. At the late Electric Exhibition of Trieste, Messrs. Ganz and Co. lighted the Csarda with eight arc lamps so successfully that the Exhibition Commission gave an order for lighting the whole of the grounds with thirty-two arc lamps of 600-candle power each. The dynamos supplying this installation were placed at Lloyd's Arsenal, a distance of over three miles from the Exhibition grounds, which distance did not, however, interfere with the successful results of the installation.

The most brilliant effects in connection with this Exhibition were, however, produced on board the Lloyd steamer Berenice, which, on the occasion of a visit by the crowned heads of Austria, was most magnificently illuminated by Messrs. Ganz and Co. with sixty-two incandescence and four arc lamps. The ship's deck was transformed into a ball saloon, beautifully decorated and artistically and most successfully lighted; this installation brought decorations to both the firm and Mr. Zipernowsky at the Exhibition in Trieste. The arrangement of engine and dynamo in this installation is somewhat interesting, and we give in Fig. 10 a general illustration of the same. A vertical Gwynne engine is coupled direct on one side to the dynamo machine, and on the other side to the exciting machine, which latter is of a larger pattern than would have otherwise been necessary; but since the speed, 750 revolutions, could not well be increased in this arrangement, a larger machine was used. The current supplies forty incandescence lamps of 20-candle power, and four arc lamps of 600-candle power each. The exciting machine was also used to supply a signal light, but during a series of experiments carried out with this installation, the current, otherwise employed for the incandescence lamps, was used to supply a large signal arc lamp of 8,000-candle power.

So successful were these experiments that at present Messrs. Ganz and Co. have in hand several installations for Lloyd's steamers, the principal one of which is that on board the Elektra. Several other successful installations carried out by this firm deserve mention here, one on board the troopship Custazza with 130 incandescence lamps, which has given great satisfaction in Austrian marine circles, and one for street illumination in Szegedin. The main street, nearly a mile long, leading to the railway station, is lighted by 20-candle incandescence lamps placed at distances of 130 ft., while the place in front of the station is lighted by four arc lamps. This is the first installation for street lighting in Austria in which the two systems of lighting have been adopted side by side, and the result is said to be highly satisfactory.—*Engineering.*

THE FIRST TELEPHONE.

By Professor SILVANUS P. THOMPSON.*

ON the 12th of May, 1862, there was met together in a fine old hall in the city of Frankfort-on-the-Main a crowded audience, eager to see and hear the latest scientific invention expounded by its inventor. The occasion was the meeting of the Free German Institute (Freies Deutsches Hochstift), a sort of literary and philosophical society, which has since domiciled itself in the historical old house where Goethe was born. The invention which attracted so notable a crowd was the telephone. The inventor was Philip Reis, a teacher of natural sciences in Garnier's Institute, a flourishing boys' school at Friedrichsdorf, near Homburg.

On one occasion previously had the telephone been publicly exhibited; namely, at a meeting of the Physical Society of Frankfort, on the 22d of October in the preceding year.

In the journal of the Frankfort Society (*Jahresbericht des Physikalischen Vereins zu Frankfurt am Main*) for 1860–61, p. 57, may be found the memoir of Philip Reis on the subject, under the title "On Telephony by the Galvanic Current." In this memoir, which shows a marvelous precision and a grasp of the subject that excites admiration and wonder, the author says: "I have now succeeded in constructing an apparatus by means of which I am in a position to reproduce the tones of divers instruments, and even to a certain degree the human voice." The inventor further says: "Since the length of the conducting wire may be extended for this purpose just as far as in direct telegraphy, I give to my instrument the name 'Telephone.'" Toward the end of the memoir it is stated that until now it had not been possible to reproduce the tones of human speech with a distinctness sufficient to satisfy everybody; adding: "The consonants are for the most part tolerably distinctly reproduced, but the vowels not yet to an equal degree." The author of the memoir in which these statements occur had been led to his invention by a remarkably suggestive line of thought. He had wanted an instrument to transmit electrically everything and anything that a human ear could hear. Accordingly he took the human ear itself as a model. "How," he argues, "could a single instrument reproduce at once the total actions of all the organs operated in human speech? This was ever the cardinal question. At last I came by accident to put this question another way: How does *our ear* perceive the total (or resultant) vibrations of all the simultaneously-operant organs of speech?" He then goes on to describe the action of the auditory ossicles when the ear is made the recipient of sound; pointing out how they execute movements and exert forces upon one another in proportion to the condensations occurring in the sound-conducting medium and to the amplitudes of vibration of the tympanum. Having stated this law of proportion between the cause and its effect, he goes on to speak of the graphic method of representing varying forces, such as those of sound-waves, by curves; and emphatically lays down that

* From the Proceedings of the Bristol Naturalists' Society.

FIG. 1.

FIG. 2.

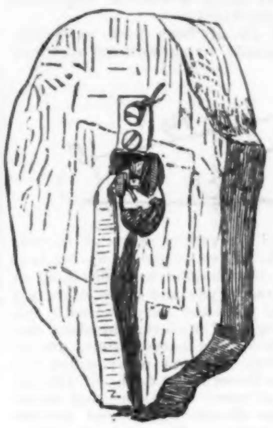


FIG. 3.

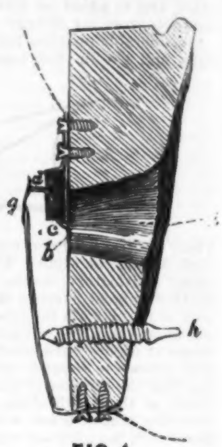


FIG. 4.

the ear is absolutely incapable of perceiving anything more than can be expressed by such a curve. After giving samples of undulatory curves corresponding to musical and to discordant sounds, he makes the following significant remark: "So soon, therefore, as it is possible at any place and in any manner, to set up vibrations whose curves are like those of any given tone or combination of tones, we shall then receive the same impression which the tone or combination of tones would have produced upon us. Taking my stand upon the preceding principles, I have succeeded in constructing an apparatus," etc. He concludes his paper by saying that the newly-invented phonautograph of Duhamel may perhaps afford evidence as to the correctness of the views which he has asserted respecting the correspondence between sounds and their curves.

The actual apparatus figured in this memoir, and exhibited to the Frankfort Society in October, 1861, is now in my possession; and I have also temporarily intrusted to me a still earlier experimental telephone, made by Philip Reis, in the form of a model of the human ear.* This interesting instrument is depicted in its actual condition and size in Figs. 1, 2, and 3, and in section in Fig. 4.

It is carved in oak wood. Of the tympanic membrane only small fragments now exist. Against the center of the tympanum rested the lower end of a little curved lever of platinum wire, which represented the "hammer" bone of the human ear. This curved lever was attached to the membrane by a minute drop of sealing wax, so that it moved in correspondence with every movement of the tympanum. It was pivoted near its center by being soldered to a

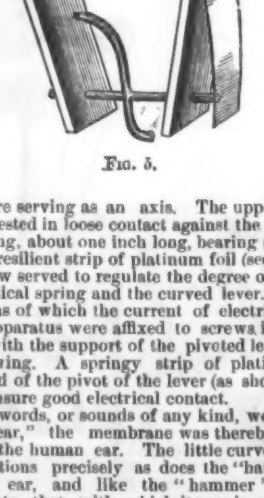


FIG. 5.

short cross-wire serving as an axis. The upper end of the curved lever rested in loose contact against the upper end of a vertical spring, about one inch long, bearing at its summit a slender and resilient strip of platinum foil (see Fig. 4). An adjusting screw served to regulate the degree of contact between the vertical spring and the curved lever. Conducting wires by means of which the current of electricity entered and left the apparatus were affixed to screws in connection respectively with the support of the pivoted lever and with the vertical spring. A springy strip of platinum pressed against the end of the pivot of the lever (as shown enlarged in Fig. 5) to insure good electrical contact.

If now any words, or sounds of any kind, were uttered in front of the "ear," the membrane was thereby set into vibrations as in the human ear. The little curved lever took up these motions precisely as does the "hammer" bone, of the human ear, and like the "hammer" bone transferred them to that with which it was in contact. The result was that the contact between the upper end of the lever and the spring was caused to vary. With every rarefaction of the air the membrane moved forward, and the upper end of the little lever moved backward, and pressed more firmly than before against the spring, making better contact, and allowing a stronger current to flow. At every condensation of the air the membrane moved backward and the upper end of the lever moved forward, so as to press less strongly than before against the spring, thereby making a less complete contact than before; and, by thus partially interrupting the passage of the current, caused the current to flow less freely. The sound waves which entered the air would in this fashion throw the electric current, which flowed through the point of variable contact, into undulations in strength. Reis himself termed the contact part of his telephone an "interrupter." That it was not intended to operate as an abrupt make-and-break arrangement, as some persons have erroneously fancied, is evident; first, because the inventor introduced delicate springs to give a following contact (like that in Blake's well known "transmitter"), and so prevent abrupt breaks from occurring; secondly, because abrupt breaks would have violated the fundamental principle to which he refers in the sentence immediately preceding his description of the instrument shown to the Frankfort Society, namely, that of creating tones whose curves were like the undulatory curves imparted at the transmitting end of the instrument; thirdly, because (in another article) he described his instruments as opening and closing the circuit in proportion to the sound wave; which obviously an abrupt "make-and-break" apparatus without a spring contact could not possibly do. The mechanism which Reis thus invented—and which is substantially alike in all his instruments—might be appropriately described as the combination of a tympanum with an electric current regulator; the essential principle of the electric current regulator being the employment of a loose or imperfect contact between the two parts of the conducting system; those parts being so arranged that the vibrations of the tympanum would alter the degree of contact, or occasion an approach and recession of the atoms of the two surfaces, and so vary the resistance offered at the point of contact to the flow of the current.

* The property of Leon Garnier, Esq., Director of Garnier's Institute at Friedrichsdorf, near Homburg, where Philip Reis was formerly teacher of Natural Sciences.

FIG. 6.

The particular form of the instrument shown at Frankfort in 1861, and described in the *Journal,* is somewhat different from the "ear." The description is taken from the *Journal:*

"In a cube of wood there is a conical hole, closed at one side by the membrane (made of the lesser intestine of the pig), upon the middle of which a little strip of platinum is cemented as a conductor of the current. This is united with the binding screw, *p.* From the binding screw, *n,* there passes likewise a thin strip of metal over the middle of the membrane, and terminates here in a little platinum wire which stands at right angles to the length and breadth of the strip. From the binding screw, *p,* a conducting wire leads through the battery to a distant station." In the original instrument there is also an adjusting screw to regulate the contact, though this was not shown in the drawing in the *Frankfort Journal.*

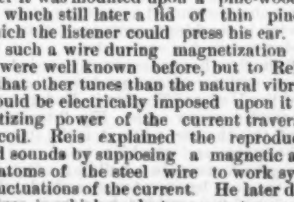


FIG. 7.

The receiver used to reproduce the sounds transmitted by these telephones is also described in the memoir of Reis. It consisted of a steel needle surrounded by a coil of wire. This was at first set up—for the purpose of increasing the sounds by resonance—upon the top of a violin, as shown in Fig. 6; later it was mounted upon a pine-wood box, as in Fig. 7; to which still later a lid of thin pine was added, against which the listener could press his ear. The sounds emitted by such a wire during magnetization and demagnetization were well known before, but to Reis is due the discovery that other tunes than the natural vibration tone of the wire could be electrically imposed upon it by the varying magnetizing power of the current traversing the surrounding coil. Reis explained the reproduction of the transmitted sounds by supposing a magnetic attraction between the atoms of the steel wire to work synchronously with the fluctuations of the current. He later devised a different receiver, in which an electro magnet was provided with

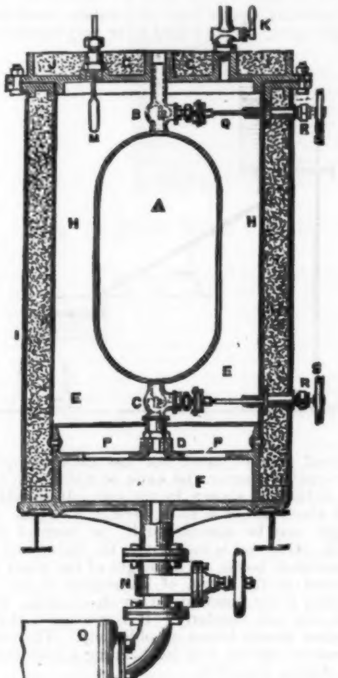
with an elastically mounted armature of iron attached to a light and broad lever, which it threw into vibrations corresponding to those of the original sound waves. With this apparatus, and a transmitter with a small curved lever in shape like that in the "ear," he was able (see Kuhn's "Handbuch der Angewandten Elektricitatslehre," 1866, p. 1,021) not only to reproduce melodies with astonishing exactness, and single words as in speaking and reading less distinctly, but even to transmit the inflections of the voice expressive of surprise, command, interrogation, etc.

Considering how far these early researches were carried, it is remarkable that their historic value has been so greatly overlooked. The transmitters which Reis devised embody—though their mechanical design is less perfect and their performance consequently less certain—all the essential principles of the telephonic transmitters in use to-day, such as Blake's, Berliner's, and Crossley's. The receivers devised by Reis, more particularly the second form, anticipate every principle essential in the more modern and convenient receiver of Graham Bell, having an electro-magnet combined with an armature capable of inductive action—*i.e.*, made of iron, elastically mounted, and having an extended surface. Bell made the very great improvement of uniting these three qualities, essential to the armature, in one, by employing as armature a thin, flexible iron plate. It is but just to the later inventors to add that both Bell and Edison have explicitly referred to Reis' prior work, Bell even going so far as to name the pages of Kuhn's Handbook from which the preceding reference is taken.

MEASUREMENT OF WATER MECHANICALLY SUSPENDED IN STEAM.*

By PALAMEDE GUZZI, C.E.

THE greatest difficulty which is encountered in determining the coefficient of evaporation of a steam generator, or the weight of vapor produced in a given time, is in measuring the water which it carries over from the boiler by mechanical action. This problem, which has acquired a greater



importance since Hirn, Leloutre, and Hallauer, by their overthrow of the old theories of the steam engine, have opened the way to the true theory, is not yet completely solved. The only solution of real importance among the many which have been hitherto attempted, is the one suggested by Hirn, and followed by the distinguished experimenters of the Industrial Society of Mulhouse, and others. Even this leaves some uncertainty, so that the Mechanical Committee of that society has recently renewed its offer of a reward for a better method. Hirn's plan consists in measuring the total heat of a given weight of steam, and comparing it with that which would be found in dry saturated steam, as given by Regnault's formula. His apparatus consists simply of a coiled tube, surrounded by water. But there is some indeterminate portion of the energy of the steam, which is so transformed as to be incapable of measurement. The vibrations generated by the flow of steam, in the coil, and in the surrounding water and air, as well as in the boiler itself, represent a transformation of heat into mechanical energy. A part is manifested in the form of sound, and is lost; only a small fraction of the remaining portion can reappear in a greater elevation of the temperature of the water. Moreover, during the flow of steam and its condensation in the coil, recent experiments have shown that there is a conversion of thermal into electric energy. It is true that Regnault's experiments were made under similar conditions; but for that very reason there is a greater need of other means of experimenting for purposes of comparison or confirmation. I have devised an apparatus, consisting mainly of a vessel which is filled with the steam of which it is desired to measure the humidity, and which is protected, as much as possible, against radiation and consequent internal condensation. Its capacity, and the weight of the vapor contained in it, being known, it is easy to ascertain the amount of dissolved or suspended water. This recipient, marked *a* in the accompanying diagram, is made of copper, in the form of a cylinder with hemispherical ends. It has an upper valve, *b*, and a lower valve, *c*, which is fastened by the screw, *d*, to the bottom of the chamber, *e*. This chamber which serves as the envelope of the recipient, *a*, is formed of the double bottom, *f*, and the cover, *g*, which are both of cast iron, and the cylindrical sheet iron wall, *h*. The sides and top are protected by non-conducting materials inclosed in the external envelopes, *i*, *j*, which are made of polished brass. The covering receives the pipe leading to the valve, *b*, and contains the stop-cock, *k*, as well as the stuffing-box, *l*, through which passes the stem of the thermometer, *m*. The double bottom, *f*, is put in communication, by means of the receiving valve, *n*, with the steam-dome, *o*, by means of the openings, *p*, with the chamber, *e*; and, when desired, with the interior of the recipient, *a*. The valves, *b* and *c*, are worked by means of the hand wheels, *s*, and the spindles, *q*, which traverse the stuffing-boxes, *r*. In order to diminish as much as possible the transmission of heat from *b* and *c* to *e*, the spindles are made hollow and pierced with holes so as to increase the surface of contact with the steam of the envelope, *e*, while the heat conducting sections are diminished. In experimenting, the air is driven from *e* by opening *k* and *m*; *k* is then closed, and after some time *b* and *c* are opened. After the air is driven from *a*, *b* is closed. After some seconds, when the equilibrium of pressure is established, *c* and *n* are closed; the cover, *g*, is lifted, and the spindles, *q*, being withdrawn, the recipient, *a*, is removed to be weighed. The total weight, less the weight of the receptacle, gives the weight of the mixture of water and steam; deducting the weight of an equal volume of dry saturated steam at the same temperature, we obtain the quantity of water dissolved in the steam. Care is needed in determining the tare of the vessel, *a*. To take account of the vapor which is condensed upon the inner walls of the vessel and adheres to them, it will be well to experiment with a generator from which no other vapor has been withdrawn, and which has not been heated for some time. Subtracting from the weight of *a*, thus filled with vapor, that of an equal volume of dry saturated vapor at the same temperature, we get the weight of the empty vessel, but internally bathed; this is the tare. The apparatus could also be applied to the determination of the density of dry saturated vapors, under high pressures, for comparison with the results of Fairbairn and Tait,* and to find the values of r, in the formula of Clausius, $A\,P\,u = \dfrac{rP}{T\dfrac{dP}{dT}}$, for comparison with those obtained by Regnault.

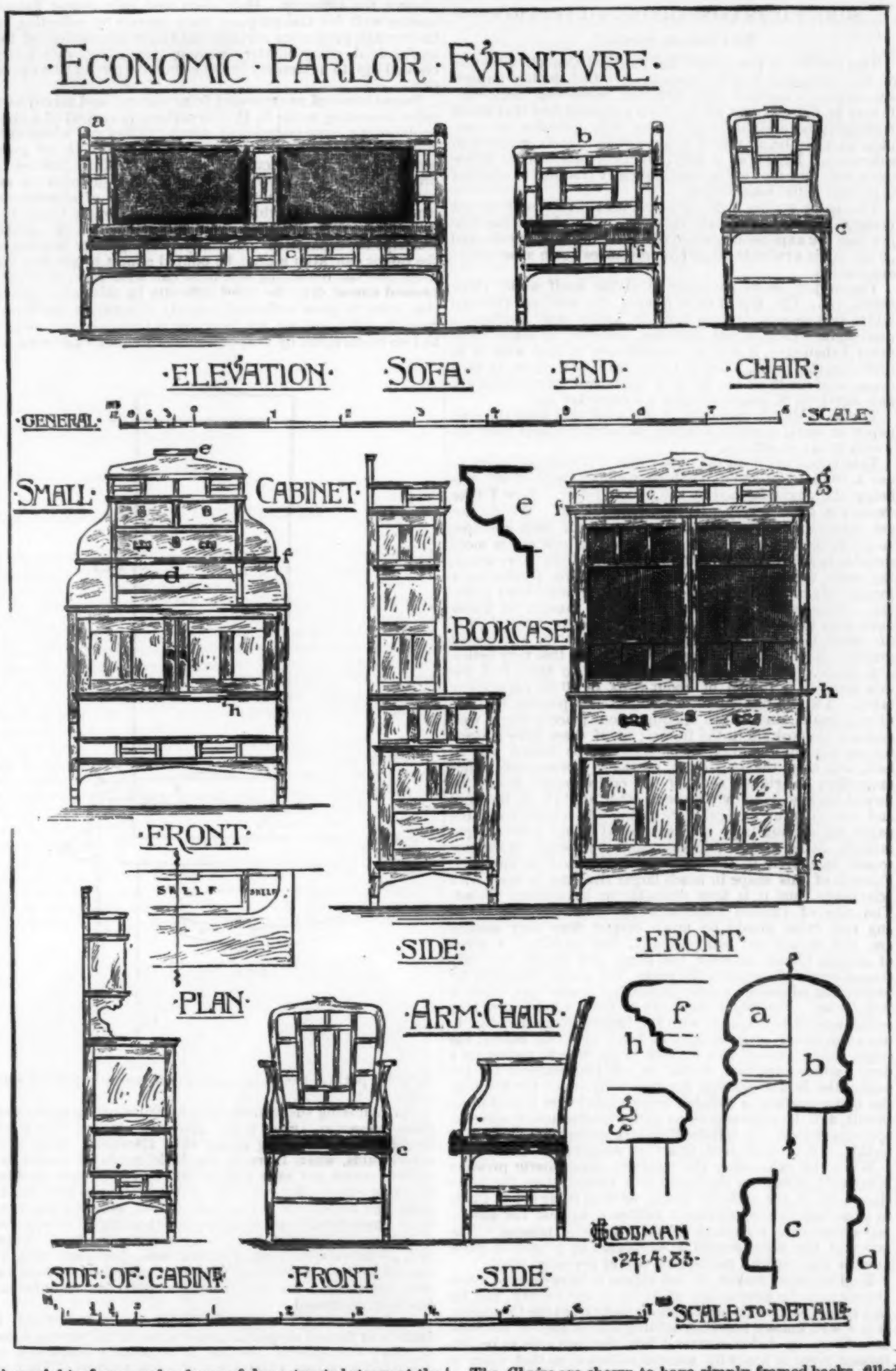
* Abridged from a communication to the Milan College of Engineers and Architects, January 21, 1877.—*The Engineer.*

* *P. Mag.* (4), lxii., 330.

SKETCHES FOR CHEAP FURNITURE.

ECONOMIC PARLOR FURNITURE (*continued*).

THE accompanying plate of sketches for above are in continuation of those recently published (see SUPPLEMENTS 389 and 391), and with them form a series for articles of parlor furniture. The designs herewith illustrated comprise the following: Chairs, Sofa, Cabinet, and Bookcase. As represented in the drawing, the *Sofa* is intended to be constructed in a simple manner: four square uprights support the framework of the seat at each angle, which are connected above by moulded rails, forming finish to the top of back and ends, the uprights at the back being terminated with circular moulded heads, as shown by detail. The seat is proposed to be covered with leather, with small projecting moulding below, a large portion of the back also being finished in a similar manner. The ends of sofa are filled in with trelliswork, the bars being 1 in. by ¾ in; a little trelliswork is introduced in the back, and the legs are connected with similar work of lighter description.



The *Chairs* are shown to have simply framed backs, filled in with horizontal and vertical bars of square section; the legs are square, relieved with slight sinkings, and are connected at front and back with single rail, and at the sides with double rails. The seats are intended to be covered with leather, finished with simple projecting moulding below. *Cabinet.*—This sketch is designed to afford the accommodation required for books, china, work, and other things which accumulate in the parlor. A cupboard is arranged the whole length of the cabinet, inclosed by double doors, above which three small drawers are placed, with a small circular shaped shelf on each side for vases, etc., supported on two cut brackets, the space between these being grooved. The top of drawers is inclosed with trelliswork, also the board below cupboard, finished at top with plain rail. *Bookcase.*—The sketch for this piece of furniture is proposed to be of a very inexpensive character; the lower portion contains a cupboard for periodicals, etc., with long drawer above, which might be replaced by two smaller ones, if thought desirable; the upper portion is devoted to bookshelves, inclosed by plainly framed sides and glass double doors in front, divided by horizontal and vertical bars. The top of bookcase is arranged for the display of

china, etc., and is inclosed with trelliswork, surmounted by a plainly moulded capping with plainly cut back. In making these sketches the object in view has been to produce furniture fitted for the various requirements in a thoroughly cheap form; plainness is therefore a marked feature throughout, and all dust and dirt traps in the way of deep mouldings (the whole of which are of a very simple character), want of space for the brush between the furniture and floor, etc., have been carefully avoided. The legs in every case are slightly tapered and relieved by small sinkings, and are intended to be fitted at the bottom with small brass or iron plates to protect same and prevent them from being chipped.

These sketches, which are intended to be finished in harmony with the preceding ones, are also suitable for execution in yellow deal, and to be painted in quiet neutral tints, and the furniture and fittings are proposed to be of white metal.—*Building News.*

SOME FACTS CONCERNING FILTRATION.

By Charles Symes.*

The process of percolation has engaged so much attention of late years that it is not surprising to find the less important although kindred one, filtration, somewhat neglected. It may be thought that all has been accomplished that could reasonably be desired for rendering this operation as complete as it can be, or that it is too simple to merit much consideration. Be this as it may, practical pharmacists know quite well that they are not unfrequently troubled to conduct it to their entire satisfaction.

The more serious difficulties connected therewith do not perhaps occur to each individual very often, hence the danger that the experience gained on one occasion is overlooked or not made available when circumstances again arise for its application.

The subject seems naturally to divide itself under three heads, viz.: The liquid to be filtered, the medium through which it is to pass, and the form in which that medium is presented. As it is not intended, however, to make these notes exhaustive, it will be unnecessary to deal with it in precisely this order. Let us rather take some facts as they occur, and see if we can by their consideration render available anything of practical value for everyday use.

The most simple operation of this kind is to filter through paper in small quantity a liquid containing a solid body for which it has no affinity.

Text books tell us at the outset that it is very necessary to use a funnel the sides of which form an angle of 60°, this being the angle formed by the folded paper. Now I take exception to this very exacting requirement. We do not get our straining bags or percolators made of such a shape, and that because our experience teaches us how much more suitable is a form in which the angle is decidedly more acute; the same volume of liquid in this latter form producing a longer column, and consequently a greater downward pressure. Then, as to the paper fitting the funnel; we know quite well that, all else being equal, the less perfectly it fits, the more rapidly filtration proceeds, so that for any useful purpose it is quite unnecessary to insist on this very orthodox shape. One has, say, a pint of fluid to filter, and for this purpose a funnel of about 8 oz. or 10 oz. capacity is taken. I would use one of the long French pattern, fold the filter in plaits, and before opening it out place it fairly well down in its position in the funnel; or, if there were reasons for not plaiting the filter, then it should be folded first in half, and then the two outer portions, representing rather more than one-eighth each of the entire paper, should be turned back so as to overlap each other slightly at the top, and not to form a very acute point. In either case, the paper while being fairly well supported would have comparatively little surface adhesion, and but small resistance would be offered to the passage of the fluid in any part. Funnels of this shape in much larger sizes can be used with advantage, but it is then desirable to have them ribbed. The ribs of funnels (especially of large ones) to be of any real value should be much deeper than they usually are, and should not run vertically, but spirally. A piece of muslin placed between the paper and funnel not only strengthens and supports the paper, but assists filtration by preventing adhesion; a cone formed of coarse hair cloth is still better. For larger sizes, say of from 4 to 8 pints, it is advantageous to dispense with the funnel altogether, and to use an inverted cone formed of linen or stout calico; the edges being fastened to a wooden hoop, which, resting on a deep earthenware pan, forms an efficient support for the paper, the liquid passing through with equal facility over the entire surface, a suitable cover placed over it excluding the air, and the process goes on under comparatively satisfactory conditions. A self-feeding arrangement can be fitted to this, if it be so desired, in a very simple manner.

When, by exhausting the receiver, atmospheric pressure is brought to bear on the liquid in a funnel, then the latter should be of the *orthodox* shape, as with it air is less likely to pass; but this requirement militates against the advantages that such a method would otherwise possess. The point of the filter should be supported by a cone of platinum or zinc, or by a packing of tow or prepared wool.

English paper makers do not appear to have devoted much attention to the production of filters in any variety, and for this reason we derive our supplies chiefly from the Continent. It is a well known fact that holding almost any of the common filters up before a strong light they are seen to be perforated more or less with minute pinholes; so that when in use it is only after these have become filled up that the whole of the solid matter is separated, and the liquid passes through bright. Each time a fresh portion of liquid is added, the disturbance caused thereby is liable to remove some of the particles which are acting as a filling, and if this occurs filtration again becomes imperfect. These filters, although very cheap, do not pay to use if time and convenience are taken into consideration. There is, however, considerable difference in the efficiency in the various kinds of filtering papers, even when free from this defect.

The presence of animal matter, as in the gray filter, increases the strength, but diminishes its working capabilities, and the existence of mineral matter therein does the latter but not the former. The papers specially prepared by Messrs. Schleicher & Schüll are practically free from all extraneous matters, the pulp having been treated with hydrochloric and hydrofluoric acids, etc. They are an example of what can be accomplished in this respect, but at the same time they are too expensive for general pharmaceutical purposes, and, indeed, are only made in comparatively small sizes suitable for analytical work. For operations requiring filters 7 inches diameter (before folding), the Rhenish papers, No. 595, are, in my opinion, the most suitable; for larger sizes the French stout plaited or plain papers, taken in all their qualities, give the best results. The French also make a paper specially suitable for sirups, thick to support the weight, and yet sufficiently pervious to allow of fairly rapid filtration. I find, however, in very large sizes, a double sheet of Rhenish paper in an inverted case of linen, as already described, answers even better.

Some fabrics, such as swansdown, close textured twilled calico, etc., filter as brightly as paper does, and may be used for that purpose as distinct from ordinary straining, provided the solid particles separate from the liquid in which they are suspended with ease, but when this is not the case they are of much less value; indeed, with paper as a medium, slimy deposits present considerable difficulty. Pepsine wine, prepared from the fresh, undried pepsine, might be regarded as typical of this class of liquids; the tendency being to choke up the pores of the filter almost immediately the operation commences. In such cases some kind of coarse straining material placed within the paper cone helps materially to obviate the difficulty. Hair cloth and thin coarse flannel answer well for this purpose; they operate by collecting on their rough projecting surfaces the larger proportion of the undissolved slimy matter, without becoming sufficiently choked up to materially impede the progress of the operation.

Succus taraxaci, as expressed from the root and mixed with spirit according to the B. P. instructions, is typical of a class containing a large quantity of starchy matter and where subsidence in a closed vessel previous to filtration is of great service. The liquor from poppy capsules, in the process of preparing *Syrupus papaveris alb.*, furnishes us with an example of a liquid containing a large quantity of albuminous matter and mucilage which, when coagulated by spirit, has to be filtered off, and here again subsidence in a closed vessel helps the separation materially. The greater portion of the liquor can, after a time, be poured almost bright into the filter, and the remaining soft mass can with care be slowly pressed almost dry; the chief difficulty in this latter operation being to press sufficiently slowly to separate the liquid from the solid, and yet not to expose it to the air long enough to lose much spirit by evaporation, as in that case some of

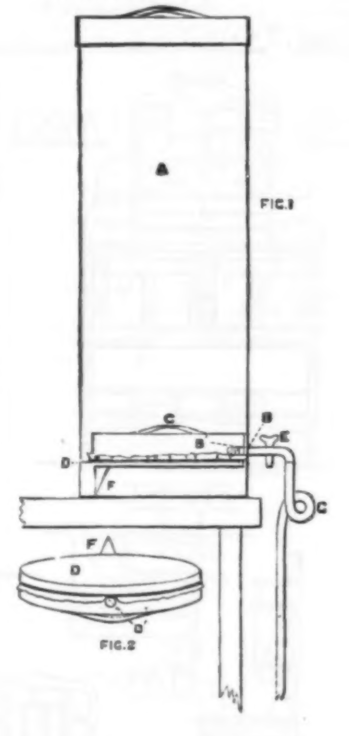


FIG. 1

FIG. 2

the solid portion would be again taken up in imperfect solution.

For removing suspended particles from strong acids, spun glass, known as "glass wool," answers best, but this might be regarded as straining rather than filtration. With ordinary liquids, when there is but little insoluble matter, absorbent cotton not only strains, but by fairly tight packing filters brightly. In cases where it is desired to save the deposit, and possibly to dry or incinerate it, asbestos paper can be recommended; the liquid passes through it slowly, but it is very strong, and it is indestructible by heat. Paper lint, as introduced from America some few years ago, answered well as a filtering medium, being both strong and absorbent; but I am not certain whether its manufacture has been continued.

So far we have considered filtration as conducted only in funnels or funnel shaped arrangements, as the various forms in which atmospheric pressure is commonly employed are described in works which treat of such matters. They are chiefly those in which a long column of liquid is carried above the point of filtration, as in Mr. Proctor's arrangement; where exhaustion is obtained by means of a syringe underneath; or suction by means of a bent tube, as described by Mr. Schacht at the meeting of the Conference at Birmingham in 1865. Recently there has been advertised a "Filtre Rapide," in which the filtering material is placed on a frame or support rising up within the cylinder and forming a space in the center into which the filtered liquid flows laterally to a receiver below. It is a compact and ingenious arrangement, but I have not had any experience from which to speak of its usefulness.

To my mind upward filtration is the direction in which we should work, and from which we may expect the best results.

Some years ago Mr. William R. Warner, of Philadelphia, invented an oil filter on this principle, consisting of two vessels in superposition, measuring altogether about 40 inches in height by 10 inches in diameter, and which is said to be capable of filtering a barrel of oil per day. This of course would depend on the nature of the oil and the temperature at which it is used.

Recently I have devised a form of upward filter in one vessel only, and have added to it a suction tube. It occupies comparatively little space, is simple in construction, efficient in action, and can be made by any tinman at little cost.

It consists of a plain tin cylindrical vessel, A, with a tap-hole, B, 1½ inches from the bottom; it is 22 inches high and 8 inches diameter. A tin tray, C, and Fig. 2, 7 inches in diameter, with a vertical rim 1 inch or 1¼ inches deep, has a hole, B, in the rim; this and the hole near the bottom of the cylinder being fitted with a short female screw of the same pitch of thread. Over the tray the filtering material, D (flannel, calico, paper supported by muslin, or any other that may be suited to the liquid to be operated on), is tied securely; it is then inverted and placed in the cylinder so that the holes, B and B', are exactly opposite one another. A tap, E, with a bend at a right angle is screwed in so that it holds the two together and assists a short leg, F, in supporting the tray in position. To the end of the tap is attached an India-rubber tube turned on itself, G, or a long glass tube of similar construction (in fact, like a large safety funnel deprived of the thistle head), which can be attached by a short piece of rubber tube. It will be obvious that any communication between the tap and the contents of the vessel must be made through the filtering medium which covers the inverted tray, and that any deposition which takes place must be on the bottom of the vessel itself or on the opposite side of the tray, but not on the filtering surface, and herein lies the special advantages of the filter I now introduce. The use of a long delivery tube is not new; it formed part of an oil filter patented by Mr. Britten, of Liverpool, some years before Mr. Schacht's application of it to his filter. Neither is upward filtration new, as already stated; but the combination of the two and in this particular form will, I believe, commend itself to any one who will give it a trial.

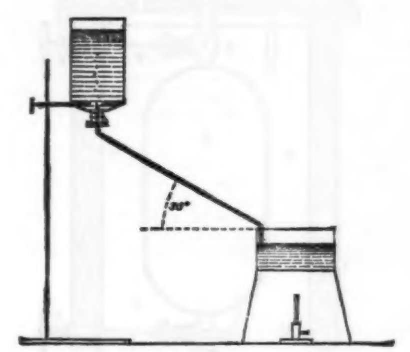
The dimensions given furnish a filter of about 3 gallons capacity at a cost of some ten or twelve shillings.

* Read before the Liverpool Chemists' Association.

[American Chemical Journal.]

CONSTANT WATER BATH.

The following simple form of constant water bath, which wastes no water, I have found to be very convenient:

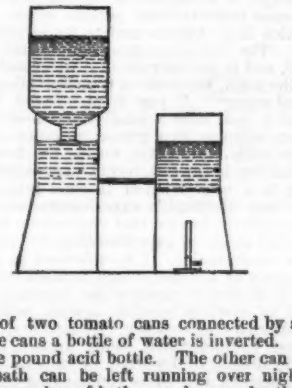


A tube of glass or metal, not less than one-quarter of an inch internal diameter, the ends of which are cut off obliquely, is bent as shown in the cut. It should make an angle of about 30° or a little greater with the horizontal. The angle may be diminished if the bore of the tube is increased. One end is inserted in the water bath, the other in an inverted bottle. The height of the water in the bath is regulated by the depth of immersion of the tube in it. The boiling is not interrupted by the feeding, which takes place slowly and regularly. It is necessary that the ends of the tubes should be cut off obliquely. The same form of tube answers equally well for keeping a constant level in a filter or drying chamber.

A brass tube is much better than a glass one, as it does not crack at the water level after using for a time. Brass tubes can easily be bent by ramming full of sand, stopping the ends, and bending them over a curved surface. A large number of baths can be run by this apparatus by connecting them with a bath fed by it.—*Charles T. Pomeroy.*

Note.—We have used for a number of years in this laboratory a form of constant water bath which was contrived by Mr. Edward Bogardus, formerly chemist to the New Jersey State Geological Survey. As I have not seen it described in print, and as it is cheap, simple, efficient, and ingenious, I will draw attention to it here.

The following cut represents the apparatus.



It consists of two tomato cans connected by a tin tube. Into one of the cans a bottle of water is inverted. We generally use a five pound acid bottle. The other can makes the bath. This bath can be left running over night without fear. A large number of baths can be run by this contrivance by simply connecting them, by means of rubber tubes, with a reservoir replenished by an inverted bottle. Old fruit cans make excellent baths. A series of holes can be punched round the lower edge of a fruit can, thus affording a distributing reservoir. Corks holding short pieces of glass tube are inserted into the holes. By means of these the reservoir can be connected by rubber tubes with a number of baths at quite a distance. The baths are made by punching a hole near the lower edge of a fruit can and inserting a cork and short piece of glass tube. When the extra vents of the reservoir are not used, they can be closed by a short rubber coupling and a pinch cock.—*Peter T. Austen, Chemical Laboratory of Rutgers College (N. J. State Scientific School).*

THE MECHANISM OF A VERTICAL ATTITUDE.

IT is certain that the associated motions that we have already pointed out "much resemble," says Mr. Vulpian, "those that the animals operated upon would have performed if they had undergone no vivisection, and if they had been submitted to the same cutaneous excitation; . . . and an observer not previously informed, and consequently not knowing that the frog had had its spinal marrow divided, might believe that its nervous system was intact if he saw the frog, when a drop of acetic acid was placed in contact with the skin of one of its sides, move, with the greatest precision, the extremity of the corresponding hind limb toward the irritated part, and rub it two or three times with its foot. He might have the same illusion should he squeeze some point of this same region continuously with a pair of tweezers, and see the frog move the extremity of its corresponding limb to a point just beyond the instrument, rest its toes thereupon, and make several strong efforts to push it away.

FIG. 1.—FROG WITH THE RIGHT SIDE OF THE CEREBELLUM DESTROYED.

It is, however, impossible to grant that the posterior part of the spinal marrow, which has been separated in the dorsal region from the anterior part of the same organ, and consequently from the brain, is endowed with will, giving this word the meaning that it ordinarily has. All the phenomena that we observe to occur under such conditions have, in spite of their great variety, the character of necessity, of fatality; they are produced constantly and are always the same, under the same circumstances, for the same given excitation. . . . We do not see herein that variety of means that the will may employ to attain some end, nor that liberty of acting or not acting that is implicated by the will such as it is admitted as a cerebral faculty." Mr. Sanders Ezn has shown, in fact, that if the flexor of the irritated limb be cut, the nervous action does not extend to the extensors that have been spared, and the limb remains motionless. The resemblance, then, between reflex medullary adaptations and the phenomena of instinct is limited, although it be real.

As regards equilibration, we know that it requires, in the majority of circumstances, only an entireness of the muscular tonicity. Now, this muscular *tonus* appears to be the expression of a banal reflex action of the gray nervous substance. Brondegeest and Rosenthal have demonstrated that the tonus of the voluntary muscles must be considered as a

FIG. 2.—FROG WITHOUT BRAIN.

FIG. 3.—FROG WITH THE RIGHT HALF OF THE BRAIN WANTING.

state of reflex contraction, and that a cutting of the sensitive nerves proceeding from a determinate region causes a cessation of the tonus therein. Likewise, a lesion of the spinal marrow may carry with it a relaxing of the sphincters, but in varying degree, while the muscular lesion is seated more or less high; and this permanent activity of the gray substance of the marrow in the region corresponding to the sphincters must exist, and in fact does exist, throughout its whole extent, since it is the spinal marrow that maintains the tonicity of the vessels of the circulatory apparatus, in the entire body. The contraction of the sphincters is only a particular case among the manifestations of such activity. The tonus of the sphincters is more apparent than that of the other muscles, because these have no true antagonists, and the effects of their permanent excitation may consequently be freely reproduced. It is the same with the blood vessels when the pressure of the blood that traverses them ceases, and no longer forms an obstacle to their collapse. But it is superfluous to demonstrate that the muscles to which equilibration is confided are in a state of permanent tonicity that becomes manifest in cases of paralysis of the antagonists.

What we have called the state of stress is very likely only a tonic equilibrium resulting from a permanent contraction, under this form, of the antagonistic muscular systems; and such antagonism appears, at first sight, sufficient to maintain the attitude in a definite modality, when once such modality has been formed.

All banal facts of antagonistic contractions and paralyses "prove with all the evidence possible," says Mr. Vulpian, "that all motive nerves, in the interval between voluntary incitations, or eventual reflex ones, are submitted constantly to a centrifugal stimulation which proceeds from the cerebro-spinal center, and which brings about in the muscles not only an incessant tendency to contraction, but also very likely a slight state of real contraction. It is this continuous contraction, whose effects cannot manifest themselves because of the reciprocal connection that exists among the antagonistic muscles, that constitutes muscular tonus. . . . The spinal marrow acts, incessantly, then, upon all the muscles, to whose motive nerves it gives origin, and produces and maintains muscular tonus therein.

In order to constitute the state of stress that determines attitude, it is clear that the excitation brought about by a motion of the medium is sufficient, whatever be the starting point of such excitation or whatever be the route that it has taken to reach the gray substance. "This continued action of the spinal marrow," also says Mr. Vulpian, "is doubtless called forth by centripetal excito-motive stimulations proceeding either from the muscles themselves, or from integuments that cover them."

The tonus of equilibration offers nothing peculiar except the large number of motive centers that are associated in the contraction in general; but it is clear that if the marrow contains all the motive centers that concur toward equilibriation in the vertical attitude, it is unnecessary to seek elsewhere the co-ordinating center of the attitude. The whole question is reduced, then, to this point: to find out whether the other parts of the cerebro-spinal axis contain any such centers indispensable to the co-ordination of attitude. The cerebellum is still regarded by some authors as filling that role of co-ordinating center of the motions generally that was attributed to it by Flourens, who made it "the exclusive seat of the principle that co-ordinates the movements in locomotion." We shall cite anew the experiments of Onimus, which formerly seemed to us, as to several others, demonstrative as regards this. While the spinal marrow is still connected with the cerebellum, the motions that correspond to an excitation (be the latter either strong or feeble, provided it be sufficient to call forth a reflex action) are always general ones. The frog in Fig. 2, although deprived of its cerebral lobes, may assume a correct attitude and preserve it. As soon as the cerebellum is harmed or destroyed, the animals rest indifferently upon one side or the other, and no longer endeavor to regain their lost equilibrium. Mr. Onimus found, on removing the cerebellum of the pigeon, duck, and goose, that the general motions persisted, but that the gait was a stumbling one, and that the attitude was no longer regularly co-ordinated; while that in the absence of the cerebral lobes, the cerebellum being intact, the contractions were co-ordinated, possessed amplitude and a certain grace, and that the motions as a whole "appeared to be more normal than in the normal state."

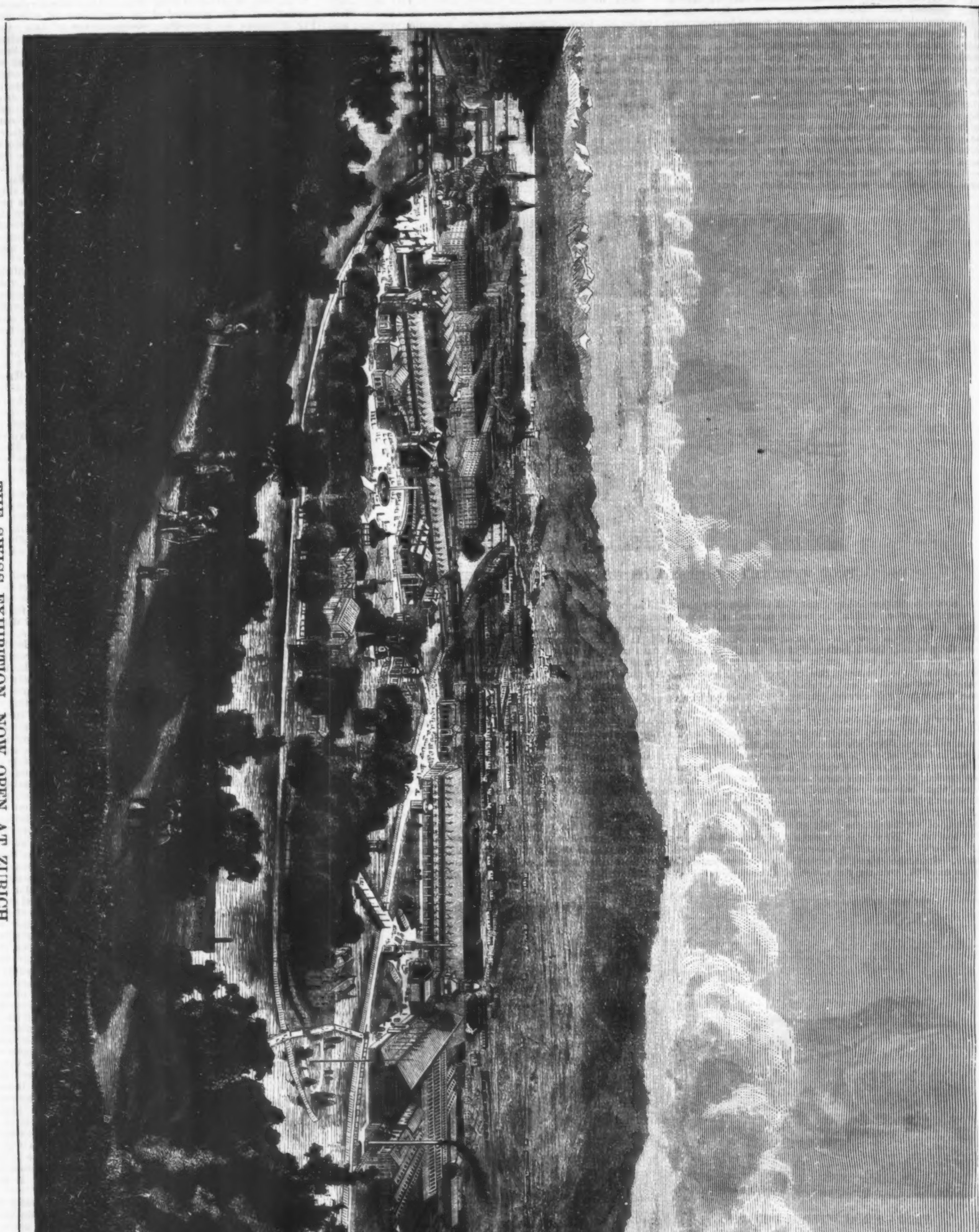
In the frog deprived of brain (Fig. 2), the attitude remains symmetrical. The removal of the cerebellum of one side (Fig. 3) causes the immediate disappearance of this symmetry and dissociates the attitude, even when the cerebral lobes are intact. If the right side of the cerebellum has been harmed, as in the animal shown in Fig. 1, the right half of the body of the animal in repose tends to fall to the bottom of the water; and the limbs on this side can never remain on a level with those on the other side. When the frog begins to move in the water, it rolls over, the right side serving as the axis of motion. The two sides, on the contrary, will be in equilibrium when the cerebellum is injured on both sides. We know, finally, that when the brain is removed, motions occur with a sort of fatality, as if the free operation of the brain protected the independence of the different associated muscular groups. In the frog of Fig. 3 the cerebral lobes have been removed from the right side; hence the entire right side of the animal experiences a permanent tonic retraction, the legs are drawn up toward the body, and the entire body leans to the right. The opposite side is not inert, but has a constant and typical attitude. The fore leg is stretched out from the thorax and the hind one from the abdomen.

On another hand, it is well demonstrated that each of the apparatus of motion is in direct relation with the brain, that the latter has the power of controlling such or such a motor, in isolating itself from the others, and that it may equally control several associated groups. Why should it not control all the groups at once, in the general association that constitutes attitude? It is nearly certain that things do not occur thus in a normal state, and that orders from the brain pass at first through the co-ordinating center or centers. But does it follow that the brain, which is naturally in relation with all the motive centers, cannot combine attitude directly? On the contrary, it belongs to the brain to supply by its direct action the wheel work that is wanting in those cases of sensorial lesions that we have analyzed; and it belongs to it to vary the attitude and to modify it for work or expression, when it is simply co-ordinated for equilibrium. Even the notion of gravity, which, under normal conditions, appears to be elaborated in the medullary centers, reaches the brain none the less, and the animal is conscious of it. The brain is capable, then, of reacting also for this impression and of rectifying motion by directly actuating either a single medullary center, or the entire spinal cord, or a simple nucleus of gray matter in the protuberance or in the bulb, or, finally, the co-ordinating center of the motions generally of life, the co-ordinating center of attitude, if there really exists a distinct co-ordinating center.

It was of importance that the attention should not be habitually averted to the profit of equilibration, and yet that it could at any instant modify the attitude. It is thus that things occur for walking, for racing, and, in general, for all the functions of locomotion which can be co-ordinated without the intervention of the attention and of the brain, and yet remain always submitted to cerebral influences. In this way thought can disconnect itself from attitude, or control with precision any motion that it pleases. It is like the coachman who is ever holding the reins and can at any instant substitute his will for that of his team. Sometimes an untimely impulse of the coachman causes an upsetting of the carriage that the horses were drawing very well of themselves. Something like this occurs when the brain acts capriciously and imposes an inopportune action upon the other co-ordinators. Such a case presents itself in the waking state in several nervous diseases, and in the state of sleep, in somnambulism. Here, in fact, directing notions are absent from the brain, because several sensations are asleep; and the motions in somnambulism are so much the more precise in proportion as sleep suppresses more or less completely cerebral spontaneity. In somnambulism there occurs a sort of dissociation of the motive influx. In the hypnotized patients of the Salpetriere, an account of whom has been published by Richer, it has been demonstrated that there is an association of the motions of expression in the absence of psychical memory, in a state in which the brain appears to be completely uninterested in the acts. Preservation of the attitude is the fundamental state in experiments on excited catalepsy; but there is no doubt with those who have studied these facts that the domain of automatism is of greater extent than has hitherto been believed, and that many acts which are in appearance rational are accomplished without the intervention of the brain. One fact nevertheless prevails in these experiments, and that is the fatalism of such acts as are accomplished under an irresistible impulse, as well as that of the reflex motions called forth in vivisections by a transverse division of the spinal marrow. We may, moreover, in all these theories just as well conceive both of the sleep of an adaptative centralizing organ during the waking of the brain, and of the sleep of the brain during the waking moments of the organ of adaptation, since the adaptation may be operated without the brain, on condition that there is an integral action of the co-ordinating center, or by the brain, which is capable of making up for every co-ordinating center. At all events, the localization of the function of adaptation in the cerebellum strikes the mind very seductively. Nothing less than a small brain would be necessary for such a centralization; and the simplicity of the apparatus is justified by the simplicity of the function, as its volume is by the number of nervous ramifications that are indispensable to it, and its isolation by the independence that it requires.

The preservation of the motions in general, in cases of lesion of the brain, is explained by the consideration that the medullary centers, entering simultaneously into action, are capable of co-ordinating a certain number of them, and to an extent that is proportionate to the number of motive centers in activity; just as the brain, likewise, is capable of putting itself in direct communication with the medullary centers without the intervention of the cerebellum. A partial or total abolition of the motions under consideration in cases where the cerebellum is entire is explained by the multiplicity of the conditions of exercise of the nervous centers upon which attitudes depend. Variations in attitude and in the motions generally are produced, in fact, in cases where the entirety of the peripheric impression or of the centripetal or centrifugal transmission has been compromised, in those where the brain acts in an intempestive and, so to speak, tumultuous manner; when the motive centers located in the spinal marrow are themselves injured, as well as in cases where the lesion is connected with the cerebellum, and neither of these states authorizes a denial of the cerebellum's role in the production of the phenomena in a normal state.

Mr. Bouillaud is nevertheless almost the only one at present who defends these prerogatives of the cerebellum. As



THE SWISS EXHIBITION, NOW OPEN AT ZURICH.

for the bulb, "the central regulating organ of the motions of expression," this does not appear to have any direct relations with attitude, and its role is limited to those motions whence result speech and the expression of the face.

It may well be, then, from what precedes, that the spinal marrow suffices for equilibration. The notion of the medium transmitted to the gray medullary matter brings about a reflex tonus of the muscular groups interested, and which constitutes the state of stress. The will intervenes, only to control the adaptation, to direct the stress, or to vary the attitudes.—*Dr. A. Nicolas, in La Nature.*

THE SWISS EXHIBITION AT ZURICH.

INTERNATIONAL exhibitions have increased in magnitude to such an extent that they do not give an exact idea of the industries and art of the several countries, however perfect the arrangements may be; for it is almost impossible to concentrate the attention on certain parts of the exposition with so much that is novel and new collected at one place. For this reason certain countries have their special expositions, or the several branches of industry have their exhibitions; such as the Electrical Exhibitions of Paris and Munich, and the Fisheries Exhibition of London.

Switzerland is now having its exhibition at Zürich, where handsome buildings have been erected and grounds laid out for the various objects to be exhibited. The buildings cover 35,879 square yards, and the grounds 119,598 square yards. These buildings are shown in the opposite engraving taken from "Ueber Land und Meer." The Industrial Hall is built adjoining the railway station on the triangular tongue of land between the Limmat and the Sihl, and two bridges built over the Sihl lead to the Mechanical and Agricultural Departments; the third part of the exhibition, the Art Gallery, is in another part of the city, on the borders of the Lake of Zürich, but communication is established between the main buildings and the Art Gallery by boats and horse cars.

One of the specialties of this exhibition is the groups of maps and relief cards of the beautiful mountainous surface of the country. In the Art Gallery, armor, weapons, porcelain, and faience ware, porcelain stoves, hearth furniture, glass paintings, needle-work, church vestments, old books, seals, and coins are exhibited in great numbers, and the majority are of the most rare and valuable kind. The exhibition was opened on the 1st of May.

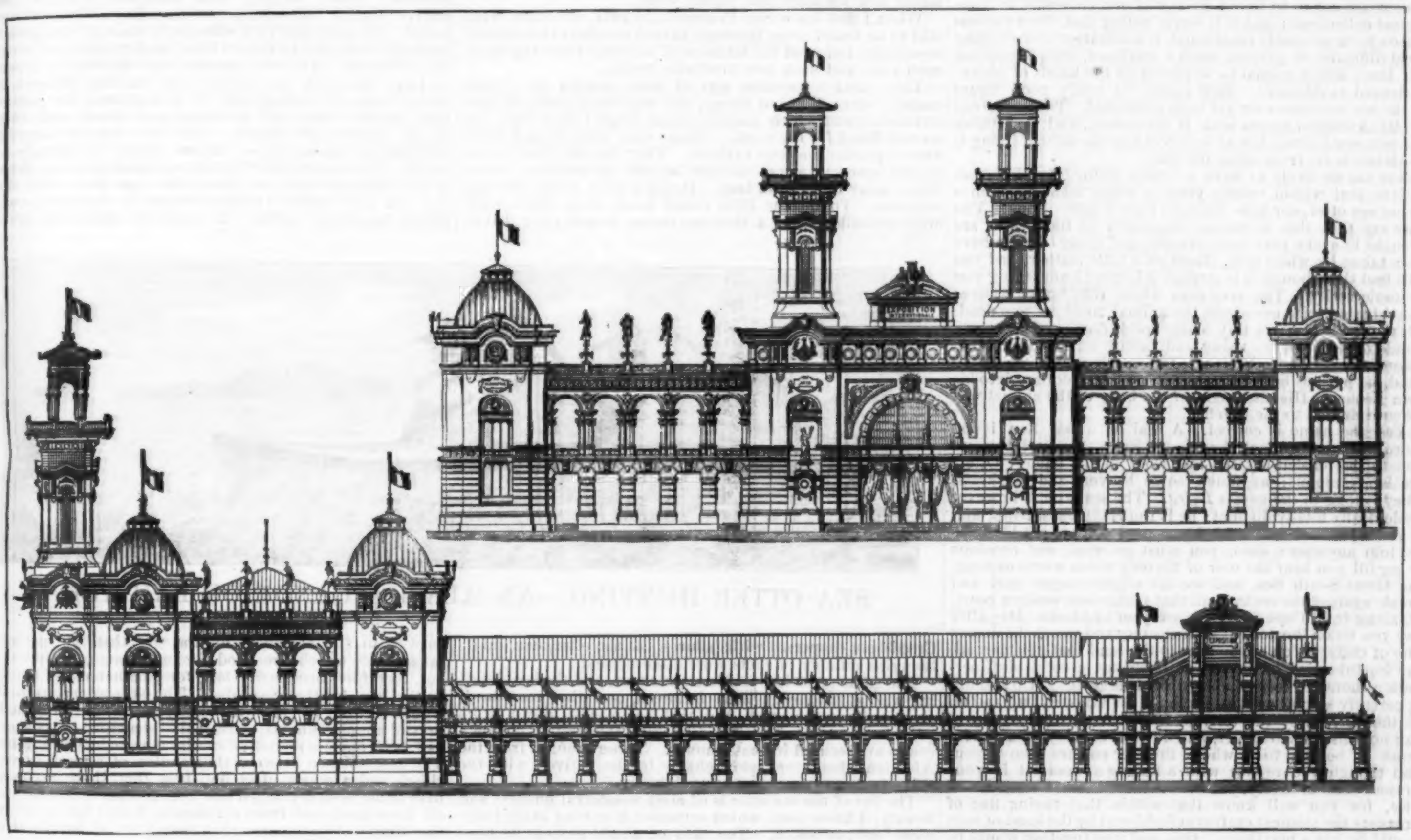
Zürich, which is a very handsome city of about 80,000 inhabitants, is situated on both banks of the Limmat where the same empties into the Lake of Zürich. The city contains many very handsome buildings of the present day as well as of former times; among which are the Technical High School and the railway depot, which latter is probably the most elegant depot in the world, and is one of the finest works of the late G. Semper, architect. The surrounding country is very fine, and persons visiting the exhibition will find many other attractions besides the exhibition itself.

THE GREAT CITIES OF EUROPE.

THE statistical researches of Behm and Wagner show the following totals for the population of the great cities of Europe: London, 3,832,440 inhabitants; Paris, 2,225,910; Berlin, 1,222,500; Vienna, 1,103,110; St. Petersburg, 876,570; Moscow, 611,970; Constantinople, 600,000; Glasgow, 555,940; Liverpool, 552,430; Naples, 493,110; Hamburg, 410,120; Birmingham, 400,760; Lyons, 372,890; Madrid, 367,280; Budapesth, 360,580; Marseilles, 357,520; Manchester, 341,510; Warsaw, 339,340; Milan, 321,840; Amsterdam, 317,010; Dublin, 314,660; Leeds, 309,130; Rome, 300,470; Sheffield, 284,410; Breslau, 272,910; Turin, 252,830; Lisbon, 246,340; Palermo, 244,990; Copenhagen, 234,850; Munich, 230,020; Bucharest, 221,800; Bordeaux, 220,960; Dresden, 220,820; Barcelona, 215,960; Edinburgh, 215,150; Bristol, 206,500; Odessa, 193,510; Elberfeld, 189,480; Nottingham, 186,660; Bradford, 183,030; Genoa, 179,510; Lille, 177,940; Salford, 176,230; Belfast, 174,410; Florence, 169,000; Riga, 168,840; Stockholm, 168,770; Prague, 162,320; Brussels, 161,820; Kingston-upon-Hull, 154,250; Valencia, 153,460; Antwerp, 150,650; Adrianople, 150,000; Leipzig, 149,080; Rotterdam, 148,000; Newcastle-on-Tyne, 145,280; Cologne, 144,700; Koenigsberg, 140,910; Dundee, 139,120; Magdeburg, 137,130; Frankfort-on-Main, 136,820; Toulouse, 136,690; Venice, 132,830; West-ham, 128,690; Kherson, 128,080; Portsmouth, 127,950; Ghent, 127,650; Kief, 127,250; Messina, 126,500; Bremen, 123,290; Bologna, 123,270; Hanover, 122,840; Leicester, 122,350; Nantes, 121,960; Saint-Etienne, 120,120; Seville, 118,890; Stuttgart, 117,300; Sunderland, 116,210; Liege, 115,850; The Hague, 113,460; Kischinef, 112,140; Oldham, 111,340; Dantzig, 108,550; Brighton, 107,530; Oporto, 105,840; Bolton, 105,240; Rouen, 104,720; Strassburg, 104,470; Blackburn, 104,010; Havre, 102,610; Kharkow, 101,170; Catania, 100,240.

INTERNATIONAL EXHIBITION AT NICE.

THE work of organizing the Nice International Exhibition is being pursued with activity under the direction of its commissary general, Mr. Felix Martin. Everything leads to the hope that the exhibition will be opened, at the time fixed upon, in a satisfactory state and in conformity with the programme elaborated by the promoters of this enterprise of national interest. While the buildings are being constructed at Nice, the committee on organization appointed at Paris under the auspices of the journal *Le Génie Civil* has begun its labors. We may recall the fact that the committee charged with the organization of the scientific and industrial part of the exhibition is composed of Messrs. Arbel, Biver, Chabrier, Dumonstier, De Fredilly, Laurens, Lepany, Maurice Levy, Em. Muller, Max de Nansouty, H. Remaury, L. Richard, C. Thirion, and C. Vincent. This committee, which meets in the office of the *Génie Civil*, is presided over by Mr. Em. Muller, and its secretary is Mr. Aug. Doumerc, a member of the juries of the universal exhibitions of 1867 and 1878.



THE INTERNATIONAL EXHIBITION AT NICE, FRANCE.

The promoters of the project seem to have well understood what an importance such an exhibition could have in so favored a region, whither during winter so many reasons attract a rich floating population eager for distractions of all kinds.

The choice of location has been made with much discernment, the spot selected being in the center of the city and surrounded by magnificent dwellings that are not to be found elsewhere.

We give in the accompanying engraving a view of the principal façade and one of the sides of the exhibition building, and shall give hereafter plans exhibiting the distribution of products. The general arrangement of the building reflects great honor upon the able architect, Mr. Salle, who is the author of it and who is directing its erection with the assistance of Mr. Auble, engineer-in-chief of the exhibition, and director of the works. The two towers of the facade, more than 40 meters in height and built exclusively of timber, will constitute a remarkable piece of work as regards the use of wood for such purposes. Each of them will be provided with elevators. Two tramways, one of them electric, the other operated by wire ropes, will permit of the ascent, without fatigue, of the sloping approaches between the gardens situated on a level with the boulevards and the esplanade on which are constructed the exhibition buildings properly so called, at 25 meters higher elevation.

As for the *attractive* part, restaurants, curiosities, concerts, shows, etc., now in course of study, grand projects are being elaborated.

We are indebted to *Le Génie Civil* for these particulars and for the engraving.

THOUGHT READING.

THE following report may interest some of our readers: A crowded audience assembled in St. James' Hall on Tuesday night, June 12, for the purposing of witnessing a public demonstration of Mr. Irving Bishop's alleged faculty for discerning or reading the unuttered thoughts of another person, with no assistance but that of manual contact. Additional interest was lent to the occasion by the announcement that Mr. Bishop had accepted a challenge from Mr. Henry Labouchere, M.P., for £1,000 to read the number of a bank-note concealed in any manner and known only to the owner, consenting to forfeit £100 in the event of failure, on the understanding that the money in either case, together with the proceeds of the meeting, should be handed over to the Victoria Hospital for Children, Chelsea. On behalf of the meeting, a committee of gentlemen were appointed to occupy the platform, including Mr. Waddy, Q.C., M.P., who officiated as chairman, Mr. Passmore Edwards, M.P., Mr. Chas. Russell, Q.C., Mr. Lane Fox, Mr. G. A. Sala, Dr. Pope, and others. The first part of the programme consisted of clever conjuring performances. By some means, Mr. Bishop managed to extricate his hands from a pair of handcuffs sent specially from Scotland-yard, and fastened on his hands by a police officer. Securely bound down in a curtained cabinet, he was yet able to ring bells, knock nails into wood, and play a guitar, while a committeeman who sat in with him testified that he felt hands slapping him, and even tugging at his watch. Mr. Labouchere was not present; and Mr. Bishop explained that as he had not received any answer to his last letter to Mr. Labouchere, he was unable to explain that gentleman's failure to appear or fulfill his part of the contract. He was ready to deposit his £100 with the chairman, and to go through with his part of the undertaking, and he proposed to hold Mr. Labouchere to his challenge. Two experiments were then given in thought reading. Mr. Bishop having retired from the hall, Mr. L. Fox concealed a small pin in an opera hat, placing it under a seat near the center of the hall. Mr. Bishop was introduced to the front of the platform blindfolded, where he took Mr. Fox by his right hand, passing his disengaged hand over his own and Mr. Fox's forehead. He then led him to the spot where the hat was, and eventually, after much handwaving, drew out the hat, from which he picked the pin, holding it aloft amid loud cheering. Prof. Ray Lankester then appeared with a £5 bank note, but Mr. Bishop refused to accept him as a medium, having failed with him previously. Mr. Waddy declined the office, as Mr. Bishop had succeeded with him on a previous occasion, and variety was desirable. Some delay occurred, as the opinion of some ran in favor of the trial of Prof. Ray Lankester. Eventually Colonel Stevens was appointed by the chairman, and Colonel Trench, to whose *bona fides* the Hon. Edward Stanhope bore witness, handed up a bank note of which no one, not even himself, knew the number. A blackboard was placed on the platform, and Colonel Stevens having inspected the note, Mr. Bishop came forward and grasped his wrist with the left hand. He had marked five spaces on the board. Throwing his right arm about in all directions, passing the hand over his medium's and his own forehead, he dotted the figures, 66,894, down on the board at intervals. Amid loud applause, this was declared by the chairman to be the correct number of the note. The conditions allowed two guesses.—*Eng. Mechanic.*

It is proposed to form a North Bohemium Industrial Museum at Reichenberg, the aim being to further, by means of a collection of the aids afforded by art and science, and by facilitation of their use, the cause of general education; but especially industrial improvement in Northern Bohemia. A German Colonial Society has been recently founded at Frankfort, under the presidency of Prince of Hohenlohe Langenberg.

THE SEA OTTER.

THE fearful negligence which prevails in this country, and which has allowed so many of our valuable products to be wasted until they are already gone, or are in sharp approach to extermination, has been to us not only a national disgrace, but viewed economically a source of loss of appalling magnitude. We have believed, or have acted as though we believed, that our resources both animal and vegetable were practically without limit, and thus we have placed no restraints upon their waste and destruction. We have allowed greedy men, for the sake of their present selfish benefit, to sweep away what should of right have been preserved for all time to come, squandering the principal instead of using properly the interest. Examples of this are too numerous and too apparent to need mention, and in scarcely any instance has this destructive wastefulness been more thoroughly shown than in the case of the sea otter; and though we may not at present be able to accomplish anything for his protection, still it is worth while to look at his past history and his present condition, for he is richly worthy of it.

Most people recognize the otter as a somewhat familiar animal, and either from stuffed skins or from illustrations, to say nothing of living specimens, have probably a tolerably correct idea of his appearance. In fact, though very shy, the otter is still found lingering along very many of our retired streams and ponds. For, as the old ballad goes:

> The otter haunts the lonely burn
> And by the loch-side plays;

and what is true of him in the Highlands of Scotland is equally true of his American representative, our own common species. Otters are quite possibly prowling around every night within ten miles of New York or of Boston.

But with the sea otter the case is totally different. Very few persons have ever seen one living or dead. Stuffed specimens are not to be found in any of our museums, or zoological collections; and it is worth noting that, for a curious reason to be presently mentioned, it is a matter of exceeding great difficulty to prepare such a specimen, even supposing the fresh killed animal to be placed in the hands of an experienced taxidermist. Still again, no really good figure of the sea otter has ever yet been published. The one given by Mr. Audubon agrees with it accurately, and is I think the best one known, but as he never saw the animal living it doubtless is far from being life-like.

Nor are we likely to have a correct picture, for I do not believe that within twenty years a white man has seen a living sea otter, nor is he likely to have a sight of one! You may say that this is strange, inasmuch as their skins are brought in every year by thousands, and many of them have been taken by white men. Read on a little further, and you will find that though it is strange it is true; I am telling you a simple verity. The very man whose rifle bullet secured the valuable prize never saw the animal until he was dead. All that he saw was a tiny black speck floating four to six hundred yards away, rising and falling on the dark lead-colored waves of the Pacific. The speck was a sea otter's head, he put his bullet through it, and fifty dollars into his own pocket. His first sight of the body of the animal was when it drifted to the beach.

Yes, the name is correct. A seal or a sea lion is no more a marine animal than is the sea otter, and you are not to be misled by the last word of his name. Otters are land animals; as much so as beavers and muskrats. They belong to the germs *Lutra*. The sea otter is however zoologically totally distinct; he is the *Enhydra marina*, and if you would see him in his home (and you are not likely to see him anywhere else), you must go west, and continue going till you hear the roar of the only ocean worth naming, the Great South Sea, and see its mighty surges curl and break against the rocky wall that makes our western coast, all along from Cape St. Lucas away on to Alaska. Day after day you sit on the deck of your steamer and watch the dreary line of cliffs. You are so near to the land that you can see the fearful swing of the sea, as it strikes a solid bluff perhaps a thousand feet of abrupt vertical ascent. Up and up, apparently step after step, it climbs impetuously, up and up further driven by the terrible force below, until at last it can hold its way no longer, and down it comes with an awful crash of boiling foam whose thunder reaches even to you; and though you rejoice with a feeling of comfort in your present state of safety, yet with it there is also a sensation of awe, for you well know that within that raging line of breakers the stoutest craft ever fashioned by the hand of man would be but a plaything. Oak and iron together would be crushed as easily as you could burst a bubble.

And yet this is the *home of the sea otter*. Here is where he lives, and enjoys life too, undoubtedly, as well as we do our quiet household comforts. Right here where you sit on the deck of your steamer, you may, if you are fortunate, see with your glass a round black ball, such as was before mentioned, dancing with a free and easy swing, perhaps conspicuous amid the white foam of the melting breaker, or at any distance outside on the dark water. You cannot physically draw near enough to examine him closely, but we will dismiss our physical encumbrances, and just step along and over the rolling surface till we have him at hand.

Sure enough, it is a sea otter, and you need no word of assurance to satisfy you that the rough tossing of the sea is to him no source of discomfort. He is rolling and swinging like a kitten perfectly rollicking with play. Here comes a crashing sea that breaks upon his back with a force that you think must surely double him up, a torn and battered mass, with that one blow; and as the tumult melts away you look sharply for his drifting body, but somehow he is not there. You wait a few seconds, and lo! up he comes safe and sound, and as spry as a cricket, and not only so, but with a very contented look in his face, for he has a clam between his paws. He had simply in the midst of the uproar, which to him was of no moment whatever, gone down to the bottom in search of his breakfast, and having brought it up with him he very coolly turns on his back to enjoy his meal, and breaking his clam he eats it with doubtless a keen relish.

Now this is no fancy sketch, for though I have never seen it, I know it to be a fair statement. I know the motion and power of the sea otter when in the water. On the land they are very clumsy, making progress by a series of heavy bounds, but in the water they are like the seals, as you may see be his flipper-like hind feet, so different from his forepaws; their movements are graceful and powerful beyond description. And time and time again have I seen all that I have here written. I have watched the huge sea lions, by the hour, within twenty or thirty feet of me, dancing and playing in and over the awful breakers that were thundering against the rocks below me with power to crush a navy. The more I looked the more astonishing always seemed their mastery of the situation. No otters were there, because they were too timid, but the movements of the one are those of the other.

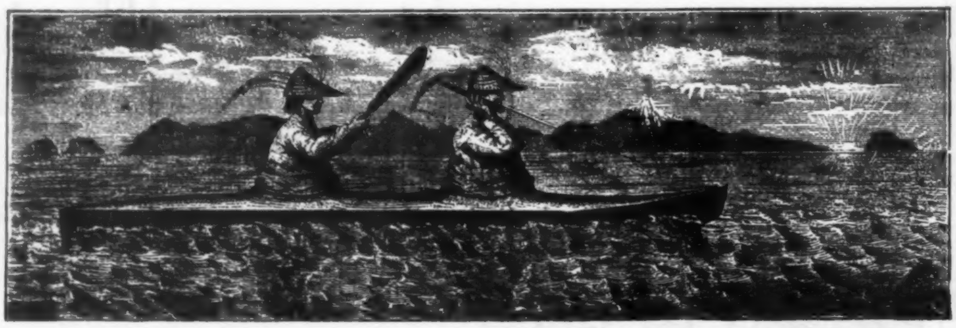
The enhydra is exclusively a native of the North Pacific coasts; it is found nowhere else. Years ago they were abundant everywhere from Lower California to Behring's Strait, and so on across by the Aleutian Islands to the Kamschatka side and the Kurlles. And perhaps it is correct to say that they are at the present time found throughout this same extent, for we may not consider them really exterminated, but in fact they are scarcely more than stragglers now on all the line of coast below Cape Flattery, and even in the far north their numbers have been shamefully diminished.

Nor is the reason difficult to detect. The richness of their coat is their ruin. I have seen an entire cargo of sea otter skins brought into San Francisco, not one of which was worth less than $75, while the finer ones sold readily for $150, and it is fair to estimate their average value at $50 the skin. With such a motive as this for their destruction we have no need to wonder that, as no restriction was imposed, they have been hunted mercilessly until on all the line of Mexico, California, Oregon, and Washington the hunting has practically ceased because there is nothing to be obtained. It is true that at one line in Washington Territory, between Port Granville and Gray's Harbor, some are still killed every year, in addition to the stragglers that are secured by the Indians. But the entire number is small, and the market supply is now derived almost exclusively from Alaska.

The former abundance of the sea otter along the Pacific coast may be inferred from the fact that, when the Prybilov Islands were first visited, two Russian sailors killed in one year on the little island of St. Paul five thousand. But it should also in fairness be mentioned, as illustrating the timidity and shyness of the species, that in the course of two or three years of such wanton slaughter they were driven away completely, and not an otter has been seen on the island now for more than eighty years.

When I first knew San Francisco, in 1854, sea otters were still to be found along the coast in such numbers that several companies followed the business of hunting them regularly each year, and with very profitable results.

They used a peculiar sort of boat, known as "otter canoes," very light but strong, and capable of going in and out over a surf which would swamp much larger craft not so well fitted for the work. Three men went in each boat, two to paddle and one to shoot. They hunted their game on the open sea, sometimes just beyond the breakers, sometimes many miles from land. It was a wild, rough life and toilsome. To hit the little round mark of an otter's head, when shooting from a dancing canoe, would have driven



SEA OTTER HUNTING.—AN ALASKA CANOE OR BAIDARKA.

Creedmoor desperate with failures, but the otter-men did it, though a number of shots were often needed.

The game grew less and less abundant, and the boat hunting was abandoned. Then followed, or rather continued, shooting from the beach, and that has worked down to its present narrow limits. The few skins obtained on our own coasts are secured in that manner. Those brought from the Aleutian Islands are taken chiefly by the natives, with the rifle, the bone-spear, and by "clubbing."

The fur of the sea otter is of most wonderful fineness and beauty; I know none which surpasses it or even in my judgment approaches it. The skin of an old male in its most perfect condition is absolutely black, but only occasionally does such a one occur. What are called prime skins are commonly of a very dark, rich brown, with a soft silkiness of fur which has a delightful effect. And yet, strange to say, sea otter fur has never become fashionable in this country or in western Europe. Almost the entire annual product finds its way to China as its market. Our ladies use small quantities for trimming other furs. I have never seen a garment made entirely of sea otter, and yet the richest fur cloak I ever saw fell far short, as it seemed to me, in elegance of what it would have been if made of selected otter throughout. As already mentioned, those choice black skins run up in price from $150 as far as special fancy may indicate. But there is no reason to suppose that the cost would prevent their use, if fashion called for it.

A large sea otter skin measures nearly six feet in length, and here comes in the peculiarity previously indicated when speaking of the difficulty of preparing a stuffed specimen for a museum. If you had been familiar with the look of the fur skins of the market, and should then see one of the animals drift to the shore after being shot, the first thought would be that he was not full grown, he was too small for that. But in trying to lift him the mystery would be explained; his skin is *too large for him*. Over his whole body it lies loose like the skin on a dog's neck. The length of an ordinary sea otter is but about thirty-eight inches, while his skin as stretched in drying measures fully five feet.

HUNTING THE SEA OTTERS.

THE sea otters are, according to Scammon in his "Marine Mammals of the Northwest Coast," the most valuable fur-bearing animals inhabiting our ocean. They are caught as far south as 28° north latitude and northward to the Aleutian Islands. The full-grown animal may be five feet in length, including the tail. The head resembles that of a fur seal. The fur is black or dark brown. Otters have been secured along the California coast for many years, but now there are but few secured. Of late they have been shot from the shore by hunters, who have wandered up and down in search of them.

The mode of capturing the sea otters between Point Greenville and the Aleutian Islands varies with the different native tribes inhabiting that coast. The Aleutians, dressed in their waterproof garments, made from the intestines of the seals, wedge themselves into their *baidarkas* (which are constructed with a light, wooden frame, and covered with walrus or seal skin); and, donning their hunting caps, plunge through the surf that dashes high among the crags, and, with almost instinctive skill, reach the less turbulent groundswell that heaves in every direction. These aquatic men are so closely confined by the narrow build of their boats, and keeping motion with them, too, that their appearance suggests the idea that some undescribed marine monster had just emerged from the depths below. Once clear of the rocks, however, the hunters watch diligently for the otters. The first man that gets near one darts his spear, then throws up his paddles by way of signal; all the other boats form around him, at some distance. The wounded animal dives deeply, but soon returns to the surface, near some one of the *baidarkas* forming the circle. Again, the hunter that is near enough hurls his spear and elevates his paddle, and again the ring is formed as before. In this way the chase is continued until the capture is made. As soon as the animal is brought on shore, the two oldest hunters examine it, and the one whose spear is found nearest its head is entitled to the prize.

The number of sea otter skins taken annually is not definitely known, but from the most authentic information we can obtain, the aggregate for the past three years has been 5,000, 1,000 of which came from the Kurile Islands; and valuing each skin at $50, amounts to the sum of $250,000. —*Min. and Sci. Press.*

THE ORIGIN OF WHALES.

By RICHARD A. PROCTOR.

THE capture of a bottle-nosed dolphin, which is now disporting itself in a tank at the Brighton Aquarium, synchronizes rather happily with Professor Flowers' suggestive lecture on whales at the Royal Institution—a lecture bringing out very effectively some of the most remarkable evidence in favor of the modern theory of biological evolution. The idea prevails that this theory depends in large degree on the resemblances existing between different forms of animal life. It is supposed, for instance, that because men and monkeys, and horses and sheep, are all backboned animals, therefore science recognizes relationship among these various classes of animals. In reality, the modern theory of development does not depend at all—whatever may have been the case with older theories—on mere features of resemblance in structures and in organs manifestly useful. It might be reasonably said in answer to any argument of the sort that the special arrangements which are good for one class of animals are not, therefore, necessarily bad for another class, but may be the best for that class also. The antecedent probability would seem to be that certain types would be found to prevail among animals, even if the structure of each order had been made a matter of special teleological arrangement. The resemblance between the handles of a screw-driver, a chisel, and a gouge does not show that these instruments have either been developed one from another or that they have all been developed from a common form; but arises from the simple circumstance that that form of handle is convenient for the work which all these instruments are intended to do. But as a matter of fact, the modern theory of biological evolution depends rather on the differences than on the resemblances between races presumed to be more less akin, is based rather on the partial disappearance of structures or organs in particular races—or rather on the way in which such partial disappearance is found to have been brought about—than on the existence of the same sets of structures or organs in different animals. For the absence, or almost total absence, of a structure or organ in any animal is proof that the animal can do very well without it, and does not need it; so that an organ found to be practically wanting is one for which nature manifestly had no occasion to make provision; and if it is found that, nevertheless, nature *has* made provision for some such organ, which yet has not come to its full development, or remains practically non-existent, then there is strong evidence in favor of natural development or evolution, as distinguished from special creative acts. For instance, the presence of the bones of the fore arm in man affords scarcely any reason for regarding him as akin to the monkey, the horse, the sheep, all of which also have the same bones; for the fore arm is obviously as useful to man, though not in the same way, as it is to those other animals; but the presence of tail bones in the human skeleton indicates kinship, because man needs no tail either for prehensile purposes, as with certain classes of monkeys, or to sweep away annoying insects, as with the horse. If such kinship were not rendered probable by the actual structure of the tail bones, with the rudiments of parts, such as in lower animals have useful purposes, it would be rendered so by the embryological evidence, which shows how the rudimentary tail in each human being began with relatively important proportions, and with accessories suggestive of future usefulness in more ways than one. To say that special creative acts might well have fashioned all animals on one general plan, if that plan were the best, is reasonable enough; but it seems altogether unreasonable to say that there would probably, or even that there might possibly, have been such a rigid adherence to one plan that those animals which had no use or occasion for certain organs would yet be provided with the rudiments of them, and in the beginning of their existence would have them in relatively full development.

The study of such an animal as the whale illustrates this line of argument with singular force. For scarcely any animal possesses so many rudimentary organs as the whale. Thus the whale wants no teeth, yet in the beginning of its existence it has teeth. It has no use for separate fingers, or, therefore, for the muscles which move the fingers; yet it has fingers, immovable—because inclosed in an unyielding integument—yet provided with muscles. It wants no hind limbs (at any rate, it gets along very well without any); yet not only has it rudimentary hind limbs, deep buried in its body, but in these can be traced many details of structure such as are found in quadrupeds. (Zoologists, by the way, nearly always speak of the whale as a quadruped.) Regarding the structure of each animal as a matter arranged originally by special creative acts, such characteristics as these are more than perplexing: they are clearly suggestive of imperfection of plan and variability of purpose. But regarded as the evolutionist regards them, they indicate the perfection and widely ranging character of the law by which, as surroundings change, animals change in character along with them. Although the idea of Deity must ever transcend (and transcend infinitely) the thoughts of man, there seems something infinitely nobler in the conception of a lawgiver whose laws take into account the occasion for change and provide for them, than in that of a workman restricted to a particular plan, and rather fashioning useless mechanism on that plan than departing from it as occasion arose. To use an illustration drawn from manufacture, we recognize wisdom in the gradual progression from the heavier vehicles of former days, when roads were bad, to the lighter carriages of our own time: whereas, when we note that the peculiarities of the old stage-coach were repeated, quite uselessly, in the first forms of railway carriages, even to the reproduction of features having no meaning in railway traveling, we recognize simply the absence of inventive faculty. Yet there are those who are absolutely offended with science for showing that throughout nature there is evidence of wisdom of the former type, though infinitely wider in scope, and *no* evidence of that want of inventive faculty which would have been suggested by the uniform application of one and the same plan under varying conditions.

Apart from such considerations as these, the theory of biological evolution, applied to different classes of animals, affords evidence such as we can obtain in no other way respecting their past history. Thus, while palæontology affords very little information respecting the past history of the cetaceans, the rudimentary organs throw some light on the question. "It appears," says Professor Flowers, "that originally whales were land mammals of fairly high organization, with a hairy covering, and complete olfactory apparatus for smelling in air, teeth of several kinds, and distinct fore and hind limbs." "Whales," he adds, "are not related to animals like seals, as if the hind limbs had been developed into very efficient aquatic organs. It is not easy to imagine how these limbs could have become completely atrophied, and their function transferred to the tail. More probably whales were derived from animals with tails which were used in swimming, like those of the beaver, and eventually with such effect that the hind limbs became no longer necessary." The whale, judged by its anatomical structure, seems more closely related to pig-like animals than to any of the carnivora. The absence of any traces of cetaceans in the Cretaceous strata has long been noted as a remarkable circumstance. Professor Flowers finds a probable explanation in the fact that many existing species belong exclusively to rivers, whence we may perhaps infer that the whole group had a fluviatile origin. It would be interesting to inquire what was the probable origin of the plesiosaurus, ichthyosaurus, and other such sea saurians, whose place the cetaceans are supposed by some palæontologists to have taken. It has long been commonly assumed that the former have necessarily disappeared, but if we consider the circumstances under which the cetaceans probably took their present position, it does not seem easy to recognize any reason for supposing that the saurians would have been dispossessed by the cetaceans. It seems extremely probable that if they still exist, they might yet scarcely ever be seen. Some accounts of what has been called the sea serpent agree well, as Gosse and other naturalists have shown, with the theory that sea saurians still exist.—*Newcastle Chronicle.*

A LIVE JEWEL.

By VICTOR SMEDLEY.

THE Northener who visits the strange and romantic country of New Mexico is prepared for many novel sights and strange customs. He has read Fosdick and Wallace and is already familiar with the ancient history and accounts of wonderful cities, strange people, and tropical foliage.

The tumble-down ruins, scattered here and there and half-naked Indians and indolent, cigarette smoking Spanish American are a disappointment, perhaps, and require a strong imagination to transform them into descendants of the bold buccaneers.

Yet after the first feeling of disappointment has worn away the tourist finds many curious and interesting sights to amuse and instruct him.

A foolish prejudice exists in the minds of most Northern people against all insects excepting, perhaps, the butterfly, and the idea of wearing for jewels live beetles has something so entirely novel in it that the sight of a beautiful Spanish woman with a great yellow and black beetle crawling over her lace-covered bosom is something that impresses itself upon their memory. The beetle worn by these ladies, though not beautiful like many of its tropical relations, is perfectly harmless, a slow mover, and possesses a shell so hard that it is not liable to be crushed upon the person of the wearer. The one from which the writer made the accompanying illustration was brought from Mexico by a lady friend, who had got over the horror of handling a live bug, as she allowed it to crawl over her hand without fear of it harming her, something which few Northern ladies would do without trembling. This specimen has been in captivity for three or four months and apparently has not partaken of any food in that time, and seems not to have suffered from its self-imposed fast, as it is still alive and crawls around in the same slow and easy manner as when I first saw it. As the illustration cannot give the color and habits of this beetle, some of the more scientific readers will find the following description interesting.

The head and thorax of the beetle Zopherus bremii is black, but the elytra is covered with a coating of yellow, which is very adhesive to the surface, but can be scraped off, showing that the natural color of the elytra is also black. The upper surface is covered with a number of bold rounded black knobs arranged in regular longitudinal lines and being much larger near the suture than on the edges. If the insect be viewed sidewise, these knobs are seen to project to a considerable height above the surface of the elytra. The under portion of the body the color is also black, but upon it are a number of round yellowish spots, which on examination with a lens are seen to be formed in exactly the same manner as the yellow of the upper surface and equally capable of being scraped off. The legs are black; upon them are scattered a number of tiny white spots of the same character, only so small as to be mere specks, just as if a little of

A LIVE JEWEL.

the finest flour had been dusted on them. It is to be found in woods hiding itself in the bark or under the trunks of felled trees, and is more frequently met with where the woodman has been at work than in the untouched forest.

A HEN RANCH.

SITUATED in West Gardiner, Me., is the farm of Fred Hildreth, who is the largest and most successful poultry farmer in that State. Not far from his dwelling is the main building for young chickens. It is not far from forty feet long, eight feet wide, double glass windows on the south side, the north side boarded and clapboarded, a glazed roof, and provided with heating apparatus and water. About the field near the farm buildings are six houses, each 14x7 feet, with a square roof, and provided inside with perches, nests, and feed boxes. These seven houses are each a duplicate of the other. They are situated in a row skirting the pasture growth of low, small trees, and are about ten rods apart. These are intended for flocks of sixty hens each, with two crowers, but at present are containing more than this number. Another set of buildings are eight hatching houses, each 6x4 feet, situated in remote parts of the farm apart from the large houses. Next are thirty individual coops, each 2x8 feet, having a shed roof and glazed opening which can be shut at pleasure. All these buildings are rat proof, tight, provided with ample means for ventilation, and are substantially built.

The hatching houses are located in quiet portions of the farm, away from the main houses. When a hen is "set," she is removed in her nest (all the laying nests are separate boxes fifteen inches square), at evening, to the hatching house, each of which houses will contain three sitting hens. They have food and water always by them, and remain undisturbed during the period of sitting. The broods are removed from the hatching houses to the chicken coops as fast as they hatch, and here they remain until large enough to forage. Then the hen and her brood are taken to the individual houses. They are carried there at evening, and confined for a day or two, after which they are allowed the liberty of the farm.

Mr. Hildreth keeps but one breed—the Light Brahma. This he has settled down upon as the best breed to keep in large numbers, although he thinks highly of the Plymouth Rocks, and says he believes they would do well kept in large numbers. He prefers the Light Brahmas for his poultry farm because they are good table fowl, good winter layers, good mothers, are easy to manage, quiet, not inclined to range—a fence four feet high keeping them within bounds anywhere—and they fill the bill so completely he has no disposition to change. The chickens begin to hatch the first of March, and the business is kept up till July. Eggs hatch better on the ground than anywhere, but when the nests are fitted for hatching, damp earth is first placed in them, and then sawdust, fine hay, or oat straw cut up fine is placed on top of it. Twelve eggs are placed under each hen; two hens are set daily during the season.

Some years ago, Mr. Hildreth, for the purpose of placing chicks in market early, commenced hatching in January, and although he had a very warm place, and everything fixed for the business just right, yet it did not succeed. It is too cold, and before the chicks can be got out on the ground they become stunted and never get over it to grow thriftly. March is as early as it will do to begin hatching, and often an April chicken will be as large in July as a March one. In regard to feeding, it may be said that Mr. Hildreth has made this branch of business a study, and that when he first began keeping hens on a large scale his losses from improper feeding were greater than from all other causes combined. He now never gives dough or soft food wet up, such as fine meal, to chickens. They want coarse food. He gives cracked corn, pinched wheat, barley, oats, and mill screenings. His feed for old hens is mainly whole corn, cracked corn, pinched wheat, and mill screenings, which is kept by them all the time. In each of the houses is a box which holds two bushels of corn, having a narrow opening at the bottom, into which a bag of corn is placed, and the hens eat at pleasure. Once a day in winter the hens have a feed of boiled fish trimmings and shorts mixed. Cotton-seed meal is also regarded as a good winter feed. Hens like a great deal of green feed, and at this season of the year eat large quantities of grass. They have the range of the entire farm, although they do not go a great distance from their houses. Near the dwelling an acre and a half of wheat has been sowed for the hens. A movable fence, one lath high, made in sections, is placed around this field and when the wheat is ripe it will be taken away and the hens given full liberty through it.

At present Mr. Hildreth has 400 chickens of different ages, and by July 1 intends to have 800. He has had good "luck," as it is termed, with chickens this year, and has not lost a dozen out of his entire lot. By the middle of July he will begin to kill the young cockerels for market, and also the hens that are coming two years old, keeping it up all the fall at the rate of about thirty a week. A hen is never kept as a layer but one winter, as after that her usefulness as a layer is gone. Mr. Hildreth does not winter a hen the second year if he can help it. The dressed poultry all goes to one firm in Boston, and is shipped every Monday. The hens are picked dry, and the work is done so quickly that generally a hen is undressed by the time it is done bleeding. Indeed, the feathers must be taken off while the hen is warm or it is quite impossible to dress them in decent shape—and buyers are very fastidious. The poultry is never packed, but is forwarded in bunches, tied up, ten or dozen in a bunch. They dress an average of 4½ to five pounds, and sell at a good price. Being consigned to one firm, they know the poultry will come on a given day, fresh, in good condition, and, accordingly, are willing to pay a good price for it.. During the winter and spring 100 dozen of eggs are sent to market weekly—every Monday—the eggs having all been sent to one firm in Cambridge, Mass., for several years past. The eggs are collected from the houses every night, and there is no week in the year when Mr. Hildreth does not get at least thirty dozen of eggs.

Everything in these poultry houses is movable. The perches are raised about two feet from the floor. The nests are placed in a row, seven or eight together, on one side of the house, about three feet from the floor. The houses are well lighted and ventilated, and even in winter there are few nights when the windows are not dropped two or three inches at the top. The perches are painted twice during the season, in June and August, with a coating of coal tar and kerosene, the mixture being about the consistency of paint, or in proportions of one gallon of coal tar and one pint of kerosene. This is sure death to vermin, and as the lice are driven from the hens by it, none will get upon the chickens. The houses need a great deal of ventilation, as it is quite impossible to give hens too much air, when in a house, especially in August.

As to the profits, of course they are variable. Some years prices of dressed poultry and eggs are higher than others. Feed for 800 hens and chickens costs a considerable sum, care must be unremitting, and attention to the hens carried late into the evening; or, in other words, the hen farmer must make a long day. Still Mr. Hildreth thinks there is a net profit of about $1 per hen, yearly, where they are well cared for. Three years ago he received $:02 for the annual sales from 514 hens. High prices for eggs led to this unusually profitable result. One great item of profit not usually reckoned is the manure. From his flock Mr. Hildreth gets about eighteen loads of manure, of twenty-bushels to a load. This he values at $100, and says: "I could not carry my farm if it not were for my hens." The manure, Mr. Hildreth says, offsets the labor of the care in the hens. He is fully satisfied from his use of hen manure upon early potatoes, onions, and cabbages, which he grows for the market, that the manure from his hens is of far more value to him than $100 worth of the best purchased commercial fertilizers would be. Taking all these things into consideration, Mr. Hildreth says that poultry keeping for large numbers pays, and he is satisfied 1000 hens could be made, by attention and care, to pay as well as 500.—*Home Farm.*

THE PARAGUAY TEA TREE.

THE superintendent of gardens and grounds attached to the United States Department of Agriculture mentions in his last report that the department has recently had numerous inquiries regarding the feasibility of growing in the United States a plant similar to the *Ilex paraguayensis*, or Paraguay tea tree, from which the leaves are stripped and used in infusion as an article of food under the name of *maté*, and gives the following description of the cultivation of the tree, and the method employed in the preparation of this article. In rich soils the tree will attain a height of from seventy to ninety feet; it is said to be confined to mountain slopes, never appearing on table lands nor the broad plains which skirt the river beds, while it is plentiful in all the moist valleys that branch out of the extensive chain of mountains that divide the waters of the Parana and Paraguay Rivers. For the preparation of *maté* proper, the leaves are dried, or roasted in cast-iron pans, set in brickwork and heated by fires underneath; when the leaves are sufficiently heated, they are pounded in stamping mills worked by water or steam power until reduced to powder, and then packed in bags by means of presses. There are three qualities or sorts of yerba known in the South American markets. The best is said to be prepared from the young leaves when they are about half expanded from the bud, called *caa-cuys;* the second consists of the full-grown leaves, carefully picked and separated from twigs, and frequently the midrib and veins of the leaves are removed; this is called *caa-mira;* the third is the *caa-gnaza*, or *Yerva de Palos*, made from older leaves, carelessly broken up with the small branches and leaf-stalks, all of which undergo the roasting and pounding process together. The leaves are also collected and dried in a similar manner to that adopted in the preparation of Chinese tea. This is called *maté* in leaf, and is prepared for use by infusion, and taken with milk and sugar in the same way as ordinary tea. *Maté* in powder is also prepared by infusion, by putting into a small vessel about an ounce of the powder, and pouring boiling water over it. As the fine dust does not fall to the bottom, but remains suspended in the water, the *maté* is taken by means of a sucker, that is, a tube terminating in a small hollow ball pierced with very fine holes. *Maté* contains theine, the same active principle as tea and coffee, but is not possessed of their volatile and empyreumatic oils; it contains less essential oil, more resin than coffee, but less than is found in tea. Chemical analyses show that it contains nearly double the quantity of theine that the same weight of grains of coffee contains, and about the same quantity as tea leaves. The Brazilians recommend *maté* as a nourishing, warm, aromatic, stimulating, and very cheap beverage, its extreme cheapness being a guarantee of its genuineness, as it is not worth adulterating.

ASSUMING the produce of labor to be 100 in Great Britain, 56 parts go to the laborer, 21 to capital, and 23 to the Government. In France, 47 parts go to labor, 36 to capital, and 17 to the Government. In the United States, 72 parts go to labor, 23 to capital, and 3 to the Government.

NEW MINIATURE BASKET FERN.

(*Adiantum dolabriforme*)

THIS charming fern belongs to a small group of Adiantums, consisting of A. caudatum, ciliatum or edgeworthii, and lunulatum, all kinds possessing the same habit, and all found in the tropics and succeeding well under similar treatment. All of them require stove temperature, and the compost which suits them best is a mixture of two parts peat and one of fibrous loam with a dash of silver sand, and they like to be kept as near the light as possible. To a certain extent A. dolabriforme resembles the old-fashioned yet beautiful A. lunulatum, but it is more grace-

ADIANTUM DOLABRIFORME

ful in appearance; its stalks are more slender and the pinnæ smaller and rounder; moreover, the deciduous habit of A. lunulatum is a great drawback to it. It is very provoking in autumn to see a plant of it in a hanging basket gradually going down until nothing is left but the bare basket itself, and the knowledge that it must remain in that state for about five months in the year is certainly not conducive to its being largely grown. In A. dolibriforme this drawback is removed; it is a thoroughly evergreen species, admirably adapted for small baskets, in which it shows itself off to perfection, and the young plants belonging to two and even three generations growing on the tips of its graceful elongated pinnate fronds with dolabriform pinnules produce a charming effect, and make it a most attractive as well as a most useful plant.—*The Garden.*

ODONTOGLOSSUM POLYXANTHUM.

FOR the magnificent spike of this rare Odontoglot, we are indebted to the kindness of E. Salt, Esq., of Fernihurst, in whose collection it flowered at the end of last month. The plant which produced this strong spike of ten flowers is, we are told by Mr. Newman (who has charge of the Fernihurst collection), in robust health; and the species is such a fine one that all must regret that the imported plants of it offered for sale are usually in such poor condition that but few survive. It is one of the discoveries of Mr. Klaboch, who introduced it from Ecuador.—*The Gardeners' Chronicle.*

THE BOTANIC ORIGIN OF COTTON.

PROF. A. DE CANDOLLE, of Geneva, has recently published a very interesting work on the "Origin of Cultivated Plants" (*L'Origine des Plantes Cultivées. A. De Candolle. Paris et Génève*, 1883), which is designed to collect and transmit the results of the diligent and laborious researches of archæologists and naturalists during the twenty-seven years that have elapsed since the time of the paper in the *Géographie Botanique*, in 1855, from the pen of the same illustrious author.

The investigations of the author of the various specimens of cotton will undoubtedly be of interest to many of our readers, and we will give them in full.

As is known, Linnæus recognized five subdivisions of cotton. Other botanists seven, eight, some even ten. One of the greatest authorities in this field, Prof. Parlotte, finds seven kinds:

1. *Gossypium arboreum*, in Ceylon, the Moluccas, Arabia, Senegal.
2. *G. herbaceum*, in Siam, China, India, Italy, etc.
3. *G. sandwichense*, in the Sandwich Islands, and other isles of the Pacific Ocean.
4. *G. hirtutum*, of the American upland cotton.
5. *G. barbadense*, in the Barbados, and neighboring islands.
6. *G. tahitense*, in Tahati. Society Islands, etc.
7. *G. religiosum* or *peruvianum*, Peruvian cotton and those kinds by whom the seed appears to adhere to the fiber.

Mr. Bowman (*Bowman's Magazine*) only distinguished three kinds, the most valuable of which is *G. herbaceum*, from which is obtained the best American harvest.

But to return to our author, after this short digression.

HERBACEOUS COTTON (*Gossypium herbaceum*, LINN.).

At the time of my researches into the botanic origin of cultivated cottons, in 1855, says our author, M. De Candolle, great confusion prevailed in the classification of the several species. Since that period two excellent and reliable works have appeared in Italy—one bearing the title "Le Specie dei Cotoni," 1866, by Signor Parlatore, late director of the Botanic Garden, Florence; the other, "Relazione della Coltura dei Cotoni in Italia, sequita da una Monographia del Genere Gossypium," 1877–78, by Senator Todaro, of Palermo. Both works are accompanied by magnificent colored plates. As regards cultivated cottons, nothing better could be desired. On the other hand, however, our knowledge of the true species, by which I understand those actually existing in a state of nature, has not made the progress that might be desired. A sufficiently concise definition of species is given by Dr. Masters, in Oliver's "Flora Trop. Africa" and Hooker's "Flora Brit. India," and I shall follow him. His views incline to those of Parlatone, who admits seven well defined and two doubtful species, while Todaro recognizes fifty-four species, two of which only are doubtful, thus ranking as species forms, distinguished for some particular characteristics, which have made their appearance and become perpetuated in the course of cultivation.

The popular names of the various species of cottons are of very little aid. In fact, there is a risk in leading the inquirer astray as to their specific origin. A species designated as "Siamese" comes sometimes from America; another one is called "Brazil," or "Ava," in accordance with the fancy or erroneous ideas of the cultivator.

We will first treat of *G. herbaceum*, the species cultivated in ancient times in Asia, and at present the most widely spread in Europe and the United States. In hot countries, to which it pertains, the stalk remains in vigor for several

ODONTOGLOSSUM MULUS, VAR.: COLOR, PRIMROSE BLOTCHED WITH CHESTNUT BROWN.

years, but out of the tropics the plant deteriorates into an annual and dies down every year under the influence of the cold of winter. The flower is generally yellow and reddens at the base. The cotton is either white or yellow, in tenor with the variety. Parlatore examined several herbaria specimens of indigenous growth and cultivated others obtained from samples found wild in the Indian peninsula. On the authority of dried specimens, furnished by collectors, who perhaps did not in all cases take the proper amount of care in verifying the spontaneous character of the plants, he deems it to be indigenous in Burmah and the Indian Archipelago.

Dr. Masters considers as unquestionably of spontaneous growth in Scinde a type called by him *G. stocksii*, which he thinks is probably the wild form of *G. herbaceum* and other

ODONTOGLOSSUM POLYXANTHUM: FLOWERS, LEMON YELLOW WITH CHOCOLATE COLORED BLOTCHES.

sorts long cultivated in India. Signor Todaro, who is not disposed to embrace many types in any one single species, nevertheless admits its identity with *G. herbaceum*. The yellow color of the cotton appears to be the natural condition of the species. The seeds do not show the short, close growth of down under the longer hairs which is peculiar to *G. herbaceum* when cultivated. Cultivation has probably extended the habitat of the species beyond the limits of its primitive home. I suppose this to be the case in the islands of Sunda and in the Malayan peninsula, where certain species appear to be more or less indigenous. Kurz mentions *G. herbaceum* in his "Flora of British India" as being a yellow or white cotton, being found cultivated as well as wild in desert places and fallow tillages.

Herbaceous cotton is called *Kapase* in Bengali, and *Kapas* in Hindoostani, which shows that both names are derived from the generic Sanskrit word *Karpassi*. It was cultivated at an early date in Bactriana, where the Greeks noticed it in the expedition of Alexander of Macedon. Theophrastus makes mention of it in a way that admits of no doubt of the subject. The tree cotton of the island of Tylos, in the Gulf of Persia, mentioned by him subsequently, was probably *G. herbaceum*, as Tylos is not very far distant from India, and herbaceous cotton becomes a shrub in a sufficiently hot climate.

The introduction of some kind of cotton into China occurred some time in the ninth or tenth century of our era, which presupposes for *G. herbaceum* a former habitat of restricted extent toward the south and east of India.

The acquaintance with and perhaps the cultivation of cotton spread in the Græco-Roman world after the expedition of Alexander, although previous to the first centuries of our Christian era. If the *Byssos* of the Greeks was synonymous with *cotton*, as is supposed by many scholars, then it was cultivated at Elis, in Greece, in accordance with the accounts of Pausanias and Pliny. Curtius and Carl Ritter, on the other hand, presume that *Byssos* was merely the name for thread, and that the thread here meant was a fine kind of flax. Evidently, cotton culture, if not altogether wanting, was not generally followed in ancient times. Now its utility would have tended to a more common cultivation of the plant after it had once been introduced in a particular locality, as, for instance, into Greece. But the Arabs, also, who spread it along the coast of the Mediterranean at a later period, as is shown by the Arabic name of *Qutn* or *Kutn*, which was adopted into the modern languages of the south of Europe, and transformed into *Cotone*, *Coton*, *Algodon*. Eben el Awan, of Seville, who lived in the twelfth century, mentions its cultivation as practical in his day in Sicily, Spain, and the Levant.

Gossypium herbaceum is the species most cultivated in the United States of America. It was probably carried thither from Europe. It was a novel crop there only one century ago, since, in the year 1774, a bale of cotton from North America was seized and confiscated at the port of Liverpool under the pretext that that country produced no cotton. Long staple or Sea Island cotton is a distinct and American kind, of which we will speak hereafter.

TREE COTTON (*G. arboreum*, LINN.)

Grows higher and flourishes longer than herbaceous cotton. Its foliage is narrower and the bracts are less laciniated, sometimes entire. The flower is generally pink, reddening near the base. The color of this cotton is always white.

According to Anglo-Indian botanists, the species does not pertain to India, as was formerly supposed; in fact, it is not much cultivated there. It is indigenous to intertropical Africa, but has been found to grow spontaneously in Upper Guinea, Abyssinia, Senaar, and Upper Egypt. The above stated facts can scarcely be doubted, since many collectors have brought it from these different countries; the plant, however, has, by cultivation, been much disseminated and intermingled with other species, and has therefore been described under different appellations in works on Southern Asia.

Signor Parlatore has classed various specimens of *G. herbaceum* to *G. arboreum*, as well as an almost unknown plant found by Forskal in Arabia. From this he concludes that the ancients were acquainted with *G. arboreum* and *G. herbaceum*. This does not appear as very likely, since the two species are better distinguished and the true origin of each is known. They became acquainted with herbaceous cotton through India and Persia, while tree cotton could find its way to them only through Egypt. Parlatore himself furnishes a very interesting argument in support. Up to the date of his work, 1866, it was not rightly known to what particular species the cotton seeds found in the tombs of ancient Thebes could be classified. They are preserved in the museum at Florence. Parlatore examined them carefully and declared them to belong to *G. arboreum*. Rossellini declared that he could not have been the victim of imposition, since he himself had first opened both the tomb and the vase containing them. After him no other archæologist has seen or found any indications of cotton among the remains of ancient Egyptian civilization. How was it that a plant so noticeable in regard both of flower and fruit was not pictured, or described, or preserved in the tombs, if it was generally known? How is it that Herodotus, Theophrastus, and Dioscorides have not mentioned it, when speaking of Egypt? The bands in which the mummies are enveloped, and which were at one time supposed to be of cotton, are of flax alone, in the opinion of Thomson and a host of other practical microscopists, from which I conclude that, if the seeds discovered by Rossellini were really of ancient date, they must have been a curiosity, perhaps the produce of some garden tree, or they might have come from Upper Egypt, where tree cotton grows wild, as is well known. Pliny does not speak of cotton as cultivated in Lower Egypt, but the following remarkable statement occurs in his writings, which has often been quoted:

"The upper part of Egypt, toward Arabia, produces a shrub called by some *gossypium*, and by others, *xylon*, whence the threads which are obtained from it have been named *xylina*. It is small in size, and bears a fruit like a nut, whence is extracted a sort of wool, which for whiteness and softness is beyond compare."

Pliny adds: "The vestments made therefrom are most esteemed by the Egyptian priests." Perhaps the cotton for the former purpose may have been obtained from Upper Egypt, or it may be that Pliny, who did not witness the process of manufacture, and had no microscope at command, may have been deceived as to the material of the sacerdotal vestments, just as certain modern observers were fully persuaded that the swathing bandages of the mummies were of cotton cloth. Among the Jews, the sacerdotal robes were of linen, and it does not seem likely that they differed in this particular from those of the Egyptians.

Pollux, born a century after Pliny, and in Egypt, expresses himself clearly respecting cotton, the yarn from which was in use among his countrymen, but he does not say whether he refers to *G. arboreum* or to *G. herbaceum*. It cannot be ascertained even, whether the cotton so used was grown in Lower Egypt, or brought thither from some period further south. Despite these doubts, it may be surmised that cotton plants, probably from Upper Egypt, were of recent introduction in the Delta. The species which Prosper Alpin found in cultivation in Egypt in the 16th century was *G. arboreum*. On the other hand, the Arabs, and after them the Europeans, imported herbaceous cotton into other countries, in preference to tree cotton, which yields an inferior staple, and requires more heat.

In my foregoing remarks on the two cotton plants of the ancient world I have relied as little as possible on the evidence afforded by their Greek names, as *βυσσος*, *σινδον*, *ξυλον*, *Οθων*, or on the Sanskrit names and derivates, as Carbasa, Carpas, or on the Hebrew names Schesh, Buz, which are indiscriminately assigned to cotton. There has been an immense amount of learned dissertation on this subject, but the better appreciation of the distinguishing characters of the species and the discoveries of their native places have much diminished the value of the opinions thus enunciated, at least in the eyes of naturalists, who prefer facts to words. Besides which, Reynier, and after him Carl Ritter, have been led by their researches to a conclusion not to be forgotten, which is that among the ancients the same names were frequently applied to different plants or different fabrics; so that in these cases, as in many others, while modern botanic knowledge enables us to recognize the species of plant, linguistic research and commentaries on nomenclature may only lead to confusion.

BARBADOS COTTON (*Gossypium barbadense*, LINN.).

The Spaniards, at the time of the discovery of America, found cotton generally grown and in use from the Antilles to Peru, and from Mexico to Brazil. This fact is confirmed by all the historians of the period. But what were the species and what the native places of these American cottons? This remains a very difficult question. The botanical distinctions between the different American species as varieties of cotton are still confused in the highest degree. Writers, including those even who have seen large collections of growing plants, are not agreed as to their characteristics. They have been further embarrassed by not knowing which of the Linnæan specific names ought to be retained, as the descriptions are insufficient for the purpose. The introduction of American cotton seed into African and Asiatic culture has also complicated the matter, as botanists in Java, Calcutta, Reunion, and elsewhere have described American sorts as distinct species under various names. Signor Todaro recognizes a dozen American species; Parlatore reduces them to three, which in his opinion correspond to *G. hirsutum*, *G. barbadense*, and *G. religiosum* of Linnæus. Lastly, Dr. Masters brings together all the American forms in a single species, which he calls *G. barbadense*, giving as its principal characteristic that the seeds are furnished with long hair only, while the Old World species have all a short growth of down below the elongated hairs. The flower is yellow, reddening at the base. The cotton is white or yellow. Parlatore has been obliged to include 50 to 60 cultivated forms in the three species which he recognizes on the evidence of specimens found in gardens and in herbaria. Dr. Masters gives a few synonyms, and it is possible that certain forms with which he may have been unacquainted would not prove conformable to his definition of his single species.

Amid all this confusion the safest course for botanists to pursue is to seek out the forms of *Gossypium* really indigenous in America, and to base thereupon botanic species or a single botanic species, leaving to the cultivated forms their ordinary and ofttimes absurd appellations, which are not unfrequently misleading in respect to origin. I offer this opinion here because no other genus of cultivated plants has impressed me so strongly with the necessity of basing our botanical conclusions on observation of natural subjects, and not of the artificial products of cultivation.

Regarded from this, the true scientific, standpoint it must be confessed that our knowledge of indigenous American cottons is lamentably backward. It is as much as we can do if we can mention two collectors who have actually found *Gossypium* growing spontaneously in a form identical with or closely analogous to this or that cultivated type.

We can seldom rely on the older botanists or travelers, as to spontaneity of growth. Cotton plants come up in the neighborhood of cultivation, the down on their seeds facilitating their casual distribution. The remarks often met with in old books, that such and such a cotton grows in such a country, often merely means that a plant has been cultivated there. Even Linnæus, in the middle of the 18th century, talks of the "habitat" of cultivated plants, and sometimes in an indefinite way.

One of the most accurate of the writers of the 16th century, Fernandez, is quoted as having described and sketched a *Gossypium* growing wild in Mexico, but the text suggests a question as to the fact of the spontaneity of the plant, which Parlatore refers to *G. hirsutum*, Linn. Mr. Hemsley, in his catalogue of Mexican plants, *Biologia Cent. Americana*, confines himself to remarking of a *Gossypium* which he styles *barbadense*, that it is found cultivated and wild. Of the latter he furnishes no proof. McFadyan speaks of three forms found both in a wild and cultivated state in Jamaica. He assigns specific names to them, and says that they may perhaps belong to *G. hirsutum*, Linn. Grisebach admits the spontaneity of a species which he calls *G. barbadense*, in the West Indies. As to specific characteristics, he admits his inability to fix them with certainty.

For New Granada, M. Treana describes a *Gossypium*, which he calls *barbadense*, Linn., which, he says, "is cultivated and semi-wild along the Rio Seco, in the province of Bogota, and in the valley of the Cauca, near Cali." He also mentions a variety of *hirsutum* growing (he does not say spontaneously) along the Rio Seco.

I cannot find any similar assertion as regards Peru, Guiana, or Brazil; but in the *Flora Chilena*, of C. Gay, mention is made of a *Gossypium* "quasi-spontaneous in the Chilian Province of Copiapo," which the author refers to *G. peruvianum*, Cavanilles. Now, this writer does not actually assert that it is spontaneous, and Parlatore claims the form with *G. religiosum*, Linn.

An important type in cultivation is that with long filaments known to Anglo Americans as Sea Island or long-staple cotton, which Parlatore refers to *G. barbadense*, Linn. He considers it as of American origin, but no one is known to have it seen growing wild.

To summarize what has been said: If historic documents are positive as to the employment of cotton in America at a period long antecedent to the advent of Europeans, very little, nevertheless, is known of the spontaneous habitat of the plant or plants which furnished the said material. In this connection we notice the absence, in the case of Central America, of works analogous to the floras which have been compiled for the English and Dutch possessions in Africa and Asia.

TIME OBSERVATIONS.

W. W. ALEXANDER.

THE correct measurement of time is not only one of the most important parts of practical astronomy, but it is one of the most direct benefits conferred on mankind by the science; it enters, in fact, so much into every affair of life that we are apt to forget there was a period when that measurement was all but impossible.

Among the contrivances which were to the ancients what clocks and watches are to us, may be mentioned the clepsydræ, or water clocks, sun dial, hour-glass, etc. About the year 780 B. C., clepsydræ of the most elaborate construction were common; but while they were in use the days, both in summer and winter, were divided into twelve hours, sunrise to sunset, and consequently the hours in winter were shorter than in summer. The clepsydra, therefore, was almost useless, except for measuring intervals of time, unless different ones were employed at different seasons of the year.

The sun-dial also is of great antiquity, being referred to as in use among the Jews 730 B. C. This was a great improvement upon the clepsydra, but at night and in cloudy weather it could not be used of course. To understand the construction of a sun-dial, let us imagine a transparent cylinder having an opaque axis; both axis and cylinder being placed parallel to the axis of the earth. If the cylinder be exposed to the sun, the shadow of the axis will be thrown on the side of the cylinder away from the sun, and as the sun appears to travel round the earth's axis in twenty-four hours, it will equally appear to travel round the axis of the cylinder in the same time, and will cast the shadow of the cylinder's axis on the side of the cylinder as long as it remains above the horizon.

All we have to do, therefore, is to trace on the side of the cylinder twenty-four lines fifteen degrees apart ($15 \times 24 = 360$), taking care to have one line on the north side. When the sun is south at noon, the shadow of the axis will be thrown on this line, which we may mark XII; when the sun has advanced one hour to the west, the shadow will be thrown on the next line to the east, which we may mark I, and so on. The distance of the sun above the equator will evidently make no difference in the lateral direction of the shadow. In practice, however, we do not want such a cylinder; all that is necessary is a projection called a "style," parallel to the axis of the earth, like the axis of the cylinder, and a dial; the inclination above a level here will be 39° 6' at the north end of the style.

The principle of both clocks and watches is that a number of wheels, locked together by cogs, are forced to turn around and are prevented doing so too quickly. The force which gives the motion may be either a weight or a spring; the force which arrests the too rapid motion may proceed from a pendulum, which at every swing locks the wheels, or from some equivalent arrangement.

In both clocks and watches we mark the flow of time by seconds, such that sixty make a minute, sixty of which make an hour, twenty-four of which make a day. Those who are not astronomers are quite satisfied with this, and a day is a word with a certain meaning. The astronomer, however, is compelled to qualify it—to put some other word before it—or it means very little to him, because the term day may mean either the return of a particular meridian to the same star or to the sun again. The term as it is commonly used means neither the one nor the other, because long ago, when it was found that, in consequence of the motion of the earth not being uniform in its orbit round the sun, the days as measured by the sun were not equal in length, astronomers suggested, with a view of establishing a convenient and uniform measure of time for civil purposes, that a day should be an average for all the days in the year. So our common day is not measured by the *true sun*, as a sun-dial measures it, but by what is called the *mean*, or average, *sun*.

For a long time after watches and clocks were made with some degree of accuracy, it was attempted to make them keep time with the sun-dial, and for this purpose they were regulated at short intervals, and ignorant persons would blame the clock-maker for making an imperfect machine that would not keep time with the sun-dial.

Having said so much of solar days, both apparent and mean, let us next consider the starting points of these reckonings. We have first the apparent solar day reckoned from the instant the true sun crosses the meridian through about twenty-four hours, till it crosses it again. Second—The mean solar day reckoned by the mean sun in the same manner. Both these days are used by astronomers. Third—The *civil day* commences at the preceding midnight, is reckoned through twelve mean hours only to noon, then recommences, and is reckoned through another twelve hours to midnight. The civil reckoning is always twelve hours in advance of astronomical. Sidereal time is reckoned from the first point of Aries, and is the only time that can be taken without several corrections. When the mean sun occupies the *first point of Aries*, which he does at the vernal equinox, the time by the mean and sidereal clocks will be the same. This happens at no other time of the year.

A sidereal clock represents the rotation of the earth as referred to the stars, its hour hand performing a complete revolution through the twenty-four sidereal hours between the departure of any meridian from a star and its next return to it. At the moment a star whose right ascension is 0 h. 0 m. 0 s. is on the meridian of Kansas City, the sidereal clock ought to show 0 h. 0 m. 0 s., and at the succeeding return of the star, or the equinox, to our meridian, the clock ought to indicate the same time again. I have a sidereal clock at No. 1416 Holmes Street, set and regulated by stellar observation made every clear night, with a forty-eight inch transit of two and three-fourths inch aperture. This instrument is powerful enough to take the passage of a star invisible to the naked eye. Time taken from ten or more stars all agree to the fourth part of a second. This proves the time to be that near correct. This time I reduce to local or "city" time, "using the tables of the "American Ephemeris or "Nautical Almanac," which gives the sidereal time at mean noon to the hundredth part of a second. A clock set by this time will be kept at the above number, also at No. 16 East 7th Street, and corrections in seconds as near as can be made by a pocket chronometer. This time taking is mainly for the benefit of the public.

Among the leading jewelers of the city there is a difference of five to ten minutes. This renders it impossible to make prompt appointments, or even to regulate a good time-piece. This irregularity in "city time" should cease. With a view to this end I have spared no pains to find the truth.

The meridian adopted is Main Street, at the intersection of 7th; the difference caused by longitude from the eastern to the western limits of the city is ten seconds.—*Kansas City Review.*

LUNAR LESSONS.

By RICHARD A. PROCTOR.

THE more the moon is studied, the clearer seems to be the evidence that she gives respecting the life history of a planet. She tells us more, perhaps, of the future of our earth than of the past; but she tells of the past too. That the moon is waterless and practically airless too, now, is certain, and, therefore, there is probably no life now on her surface, though for those who like such fancies the belief is always open that there may be creatures on the moon utterly unlike any with which we are acquainted on earth. Yet the moon's face tells us of a remote youth—a time of fiery activity, when volcanic action even more effective (though not probably more energetic) than any which has ever taken place on this globe upheaved the moon's crust. But so soon as we consider carefully the features of her surface we see that there must have been three well marked eras of vulcanian activity. Look at the multitudinous craters, for example, around the Metropolitan Crater (as Webb has happily named it) Tycho. They tell us of century after century of volcanic disturbance—but they tell us more. They mark a surface which varies in texture, and therefore in light-reflecting power, in such a way as to show that the variations were produced long before the volcanic action began by which the craters were formed. For the variations of texture are such as to mark a series of streaks—some of them two or three thousand miles in length, and many miles in breadth, extending radially from Tycho. Craters lie indifferently on these brighter streaks and on the intervening darker spaces, and some craters can be seen which lie right across a bright streak with parts of their ring on the darker regions on both sides of the streak. Of course, this proves that the craters were formed long after the great streaks. When the streaked surface was formed, it must have been tolerably smooth; for we see the streaks best under a full illumination, and there is no sign of any difference of elevation between them and the darker ground all round; they are neither long ridges nor long valleys, but mere surface markings. Yet must they have been formed by mighty vulcanian disturbance, such, indeed, as we may be certain went on at the early stage of the moon's history, to which these radiating streaks must be referred. It seems clear that, as Nasmith has illustrated by experiment, they belong to that stage of the moon's history when her still hot and plastic crust parted with its heat more rapidly than the nucleus of the planet, and so, contracting more quickly, was rent by the resistance of the internal matter, which, still hot and molten, flowed into the rents, and spreading formed the long, broad streaks of brighter surface. It seems as clear that the next stage of the moon's history (after many thousands, perhaps millions, of years had passed) was one in which the cooled crust, still plastic, contracted little, while the still hot nucleus contracted steadily, so shrinking from the crust, which, under the action of gravity, closed in upon the nucleus in such sort as to form a wrinkled or corrugated surface. This was the second era of lunar vulcanian disturbance. The third was the era of great volcanic eruptions, during which the mighty craters were formed which are so numerous on the lighter tinted higher regions of the moon's surface. Were there no seas or oceans on the moon at this time? It is strange if there were none, when we consider the connection which exists on the earth between the activity of the great volcanic vents and the proximity of water. It is stranger still if we consider that those regions where, if water had ever existed on the moon, it would have formed seas, are without exception characterized by a different tint, and a different surface contour, from what we find in the regions which would in that case have formed the lunar continents. All the lower levels are dark, are much more uniform, and are marked by few craters, and those small. This is no mere accident or coincidence. It is a feature which we are justified in regarding as characteristic; and, so regarded, it seems to force upon us the conclusion that those lower levels are in reality old sea-floors, formed in a different way from the higher levels, and therefore presenting a different tint and reflecting a different amount of light.

When we thus recognize in the moon the three stages of past vulcanian energy which Mallet and Dana have recognized (though the evidence has not been quite so obvious) on the earth, and the signs also of a past fitness for the support of life, seeing that the presence of seas implies also the presence of an atmosphere dense enough to make the boiling-point of water not too low, we recognize the significance of the evidence which the moon gives respecting the earth's future. What has happened to her will happen also to our earth, though doubtless with variations in details corresponding to different conditions.

Yet science has good reason for regarding as exceedingly remote the time when the earth will be at the stage of planetary development which the moon has reached. If the earth's crust, God's work, whose teachings, therefore, if we can but read them aright, are God's words, speaks truly, it is certain that tens of millions of years have passed since even that stage of the earth's life through which she is now passing began. But suppose, for the sake of argument, we put twelve million years only as the time which has elapsed since the earth and moon were at the same (necessarily much earlier) stage of planetary life. The earth's mass exceeds the moon's 81 times, and therefore at that time she had 81 times as much heat to part with as the moon. But her surface is now (and the proportion cannot have been very different then) only some 13½ times greater than the moon's. Thus, since 81 contains 13½ six times, the earth has parted with her heat at only one-sixth of the rate which would have made the supply last just as long as the moon's. Each stage of the earth's cooling, or of the earth's life, has been six times as long as the corresponding stage of the moon's, and the 12 million years of earth history correspond to about two million years of moon life. Ten million years ago, then, the moon was in the same stage of planetary life that the earth is now passing through. But those ten millions of years of moon life correspond to sixty millions of years of earth life. Wherefore, on the very moderate assumption I have made as to the time which has elapsed since earth and moon were both young, sixty millions of years would have to elapse before the earth would have reached the stage of life through which the moon is now passing.—*Newcastle Weekly Chronicle.*

PAPER is now made which closely resembles satin. Common paper is covered with size, and moist asbestos is sprinkled over it. The asbestos is dyed, and with aniline colors desirable effects are produced.

A VERY LARGE GAS MAIN.

THE largest gas main in the world is being laid through Westminster. Its diameter is 4 feet, and more than 23 miles of this 4 foot main, in four diverging lines, have already been laid from the great gasworks at Beckton, by Woolwich, the work having been begun ten years ago; but the Gas Company only began a month or two ago the work of continuing one of the lines of the great main from Horseferry road, Westminster, right through the heart of London, to Goswell road, St. Lukes, where is the chief district station of the company. The section of main being laid will be 3½ miles long, which will make the length of the entire main from Beckton on this route about 17½ miles. Some interesting experimental data on the flow of gases through a large long pipe ought to be obtainable from this.

THE BURNING OF LIGNITE IN SITU.*

By CHARLES A. WHITE.

TRAVERSING those portions of Colorado, Wyoming, Montana, and Dakota which are occupied by the Laramie Group, one often observes that portions of its strata which are exposed in the bluffs and butts have a conspicuous brick-red color. Upon close examination of at least a large part of these reddened strata it is evident that they originally bore the buff, bluish, or yellowish colors of their associated strata, and that they have received their present red color from the same source that bricks do, namely, from heat. Also scattered upon the slopes and among the debris where these reddened strata exist, there are frequently to be seen masses of slag, such in appearance as result from furnace fires or from the consumption of impure coal. Much of it is plainly seen to consist of partially fused rock, and masses are common which have the appearance of true volcanic lava; to which source indeed many persons have believed them due.

Dr. Hayden made mention of these phenomena in his reports and others have done the same to some extent; but probably the fullest and best description of them that has ever been published was given by Mr. J. A. Allen in the proceedings of the Boston Society of Natural History, volume xvi., pages 246–262.

Professor, James D. Dana has also some important remarks upon the subject in his Mineralogy (1880), page 763; but my object in again calling attention to this subject is to make some suggestions as to the origin of these fires and the time within which they have taken place.

During my examination of the Laramie Group in Northeastern Montana last summer I had good opportunities for making observations upon the phenomena connected with the burning out of lignite beds there. In that portion of Montana which is traversed by the lower portion of Yellowstone River, the Laramie Group contains several distinct beds of lignite which occur at irregular intervals, ranging from near the base of the group to its summit. These lignite beds vary from mere carbonaceous seams to five or six feet or more in thickness. Practical tests that have been made of the product of many of the beds show it to be readily combustible, but it is not so durable and serviceable a fuel as could be desired. In all that region, not only in the valleys but upon the uplands, the Laramie strata have by erosion become abundantly exposed in the bluffs and bad-lands in and near the valleys, and also in the knolls and gullies upon the upland surfaces. Beds of lignite are frequently brought to view in the larger of these exposures, and traces of them are also occasionally seen upon the grassy upland surfaces. Although the beds have been fired at hundreds of places it is only in a few places that those which are now exposed are seen to have so suffered near their present exposures.

In several instances, however, I was able to trace within a short distance a bed of lignite from a point where it was unchanged and associated with yellowish and carbonaceous sandy shales and sandstones both above and beneath it, to a point where it had been burned out. At such points the place of the lignite was represented by a thin layer of unmistakable ashes containing masses of slag which had resulted from the burning of the lignite together with impurities, and the shales for several feet in thickness above and below had been reddened by the burning. Furthermore, I found at three different places in that region a bed of lignite still burning beneath the surface. Smoke was given off through fissures in the earth and the odor of burning coal was perceptible at a considerable distance. Heat was perceptible to the touch at the surface and it was too great for the hand to bear when thrust down into the fissures, which were caused by the falling in of the superincumbent strata as the lignite consumed. The burned-out portion near by presented a like appearance with that which has just been described and where the fire had been long extinguished.

There being no question as to the fact of the burning of these lignite beds beneath the surface, I endeavored to learn how the ignition had taken place, and when the beds began to be burned out. There seems to be only two ways in which their ignition could have been accomplished. One is by spontaneous combustion and the other by contact at exposed places of prairie fires, or fires caused by human agency. While forest fires may sometimes have resulted from lightning, it is not thought probable that a bed of lignite *in situ* could be thus ignited. I believe that in a great majority of the cases ignition has taken place spontaneously, like that which is often seen in progress in the piles refuse of coal that collect about the mouths of coal mines; and yet it is probable that in some cases the firing has been caused by the burning of grass and other vegetation upon the adjacent surface, caused by human agency.

Although, as already stated, beds of lignite are still burning at a few localities, there is evidence that of the many thousands of cases of such burnings that are known to have occurred, a large part of them are very ancient, probably more ancient than the artificial introduction of fire upon the continent.

The great erosion that the strata of the Laramie Group have everywhere suffered, even in regions where they have been little disturbed, has already been referred to. Upon the uplands of the regions examined by me last summer numerous butts and knolls occur, upon the very summits of which are little patches of the heat-reddened shales, and the slopes of which are strewn with the slag of former lignite-fires. These are evidently the only remaining traces of beds of lignite that once existed at or above the horizon of the tops of these knolls. Furthermore, on the upland surfaces more or less distant from such knolls, one often meets with masses of the well known slag which could have been transported there by no known agency, but which have doubtless settled down from the horizon where they were produced by burning lignite, as the surface was afterward lowered by erosion. These examples do not occur where erosion has been most rapid, but on the contrary they are where the minimum rate of erosion has occurred.

Such examples seem to prove conclusively the great antiquity of many of these lignite-fires, and if, as is supposed, these fires took place by spontaneous combustion as the beds of lignite became by erosion successively exposed to atmospheric influence, there is no necessity for considering the limit of their antiquity with reference to human agency in production of fire. Indeed, taking this view of the matter there appears to be no reason why the earliest of these fires in the Laramie lignites may not have occurred as early as, if not earlier than, later Tertiary time.

* Published in the *American Journal* in advance by permission of the Director of the U. S. Geological Survey.

NITRATE OF AMMONIA.

AT a recent meeting of the Chemical Society, Mr. V. H. Veley read a paper on "The Rate of the Decomposition of Ammonium Nitrate." The author has measured the rate at which gas is evolved by heating pure ammonium nitrate at a constant temperature. He has arrived at the following conclusions:

That the rate of decomposition into nitrous oxide and water is dependent not only on the mass of the salt, but on the proportion of free nitric acid present. If the reaction of the salt be rendered alkaline, the rate gradually increases as the proportion of free acid increases; a period of maximum velocity is then reached, corresponding to the greatest proportion of free acid; the rate then slowly decreases with the decrease of free acid. An excess of ammonia completely stops the reaction, even when the temperature is raised 50° or 60° above the normal temperature of decomposition. If the reaction of the salt be rendered acid at starting, the rate of decomposition gradually decreases as the acid decreases. After heating the salt for thirteen to sixteen hours the rate of change becomes practically constant.

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